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CONTENTS

OF THE

FEBRUARY NUMBER.

MANUAL TRAINING IN CANADA. By ALBERT H. LEAKE .. 375
BY MANY HANDS .. 380
WITH OUR CHILDREN .. 383
N.U.T. NOTES .. 384
NOTES FROM THE NORTH .. 385
THE TEACHING OF WORKSHOP MATHEMATICS. By FRANK CASTLE, M.I.M.E. .. 388
COMENIUS AS AN EDUCATOR. By JAMES S. LAWSON, M.A. .. 390
A BELATED EDUCATIONAL REFORMER .. 392
WELL-KNOWN TEACHERS AT WORK. Mr. James Watson, Leylands Board School, Leeds .. 393
NATURE STUDY FOR THE MONTH. By J. O. BORLEY, M.A. .. 396
HISTORY DAY BY DAY .. 398
THE INSPECTOR'S NOTEBOOK .. 400
A LESSON ON THE STUDY OF A PICTURE. "The Inside of a Stable" (Morland). By FRANCIS J. FROST, B.A. .. 401
OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK .. 402
PHYSICAL TRAINING. A Progressive Course for Elementary Schools. By H. RIPPON-SEYMOUR, A.C. .. 403
A PLEA FOR THE PRODUCT. By C. W. CROOK, B.A., B.Sc. .. 405
OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE. By A. T. FLUX .. 406
LOGIC FOR L.L.A. AND LONDON MATRICULATION. By T. E. MARGERISON, M.A. .. 410
OUR CERTIFICATE COURSE FOR 1903. By G. COLLAR, B.Sc. 412
PHYSIOGRAPHY .. 415
CHEMISTRY .. 416
ELECTRICITY AND MAGNETISM .. 417
THEORETICAL MECHANICS .. 419
OUR QUERY COLUMN .. 420
OUR FRENCH PRIZE COMPETITION .. 424
THE EDITOR'S TABLE .. 425

VOL. XXIII No. 8

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MANUAL TRAINING IN CANADA.

BY ALBERT H. LEAKE,

Director of Macdonald Schools for Ontario; Inspector, Ontario Education Department.

DURING the last three years Canada has been in the eyes and minds of the people of the British Isles more than any other country of the world, with perhaps one exception. This is all the more gratifying from the fact that no country has been more misunderstood or maligned through utter ignorance. Many causes have contributed to this better understanding—a growing and more accurate knowledge of her climate, her resources, and her people; her loyalty and generous contributions to the assistance of the mother land we all love so much; her marvellous development along agricultural and industrial lines; and her educational systems, and the changes that are being effected in them. It is with the last of these causes that this article attempts to deal.

Within the last ten years the greatest change that has come over the educational outlook of the world has been the trend towards the practical, whatever the practical may mean. The old idea that education (a much abused word) consisted of the mere gathering of facts, the massing of knowledge, is dying, and dying hard; the examination fetish is being slowly but surely strangled; and the more rational view that the school should touch life at as many points as possible, and that school life should be a type in miniature of that larger and fuller life to be lived by the adult, is beginning to prevail, and it was the recognition of this rediscovered purpose of all educational effort that gave birth to the manual-training movement in Canada.

The honour of bringing these ideas within the region of practical experience belongs, in Canada, to Professor James W. Robertson, Commissioner of Agriculture and Dairying for the Dominion. He is but another illustration of the busy man finding time for doing still something more. There is no man, either living or dead, who has done more for Canada and her people, or who has a greater and more abiding faith in her ultimate destiny among the nations of the earth. It is a strange coincidence that the man who has done most for manual training in Sweden, and perhaps in the world, and the man who has made it a practical possibility in Canada, should both have received their preliminary training in the direction of agricultural operations. There may be something in the study of nature's problems which leads a man of inquiring mind to take a broader and more comprehensive outlook on the affairs of practical life, and to see more clearly the vital needs of humanity.

During the professor's frequent visits to England and other countries, he had noticed the tendency of all efforts educational, had seen manual training in practical operation, and returned convinced of the good results that would accrue to the children and schools of Canada if manual training and manual-training methods were introduced. In his work for the improvement of agriculture he had become seized of one fact—seeing is believing. In other words, he had made up his mind—and his judgment had been justified by the results—that the best way to introduce any reform was to show the proposed alterations in practical operation by means of an object lesson to the people; and this was the plan adopted in the present instance. Many speeches—more or less practical, generally less—have been delivered on manual training, and Professor Robertson has added to that number; but he has never made a speech without being prepared with a plan to show, by a practical example, the feasibility of the course he was advocating. As a first step, he determined to set aside a portion of his income each year towards the establishment and maintenance of a manual-training school in Ottawa, and hoped, by persuading several of his friends to follow the same course, to show the people of the city and the members of the legislative assembly what manual training was, and of what it was capable. Seeking friends to aid him in this project, he approached Sir W. C. Macdonald, and so eloquently and forcibly presented the case to him that Sir William at once agreed to give a sum sufficient to equip

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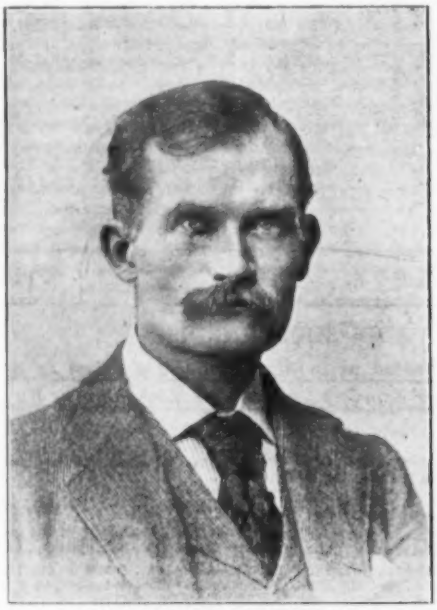
and maintain one such school in every province for a period of three years. It must be remembered here that the Dominion is divided into seven provinces, and that each



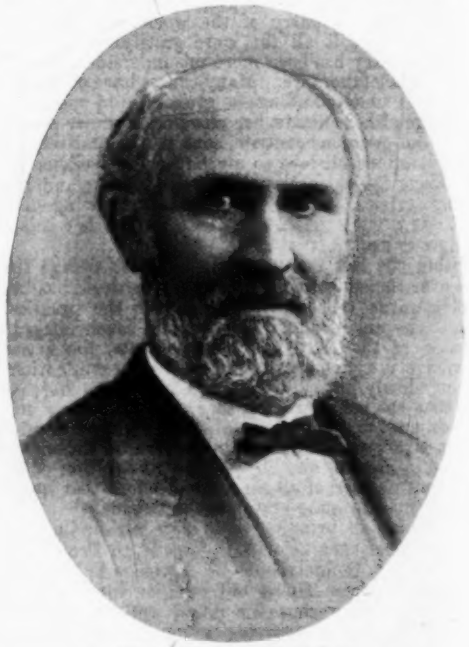
PROFESSOR JAMES W. ROBERTSON.

of them has its own educational system, controlled and carried on independently of the Federal Government established at the capital. As the end in view was the adoption of manual training by the different educational authorities, it was necessary that one such school should be located where those authorities could watch it in actual operation. In this connection the vast size of the Dominion must not be lost sight of. It was once thought in England that the visitor to Montreal could run over in the evening and dine with friends in Winnipeg or Vancouver; but it is now recognised that it takes as long to traverse the continent as it does to cross the Atlantic. This is a country of magnificent distances, and the very distances seem to conduce to a breadth and depth of thought, width of outlook, and a feeling of independence and freedom that are unknown to the peoples of the older and more crowded countries of the world.

The name under which the movement was inaugurated was the "Macdonald Sloyd School Fund," the professor being of the opinion that Sloyd, as set forth at Näas, offered the most rational basis on which to found a system that would best fit the conditions to be found in Canada. The word "system," as applied to manual training, has become of ill repute, and is only used because for the present no better can be found. Many of the so-called systems have so much system that there is very little room left for manual training. The word brings to mind the harm that has been done to the cause of rational education by the senseless squabbles between teachers unable to see the fundamental principles on which all schemes are based, and who fix their minds on the minor differences that exist, always have existed, and always will exist. The term "Sloyd," for some reason or other—perhaps its foreign appearance—failed to "catch on." The new subject was constantly referred to as manual training by speakers and writers, and it was decided to change the name, while keeping to the original conception of the form that the work should take.

Such was the comparatively modest plan at the commencement of the movement; but it was soon found that the demand for schools of this kind was almost too great to be resisted, and considerable enlargement became necessary. There are now over forty centres in the Dominion, the equipment and maintenance of which are borne entirely by Sir W. C. Macdonald. Sir William is best known, perhaps, to the outside world as a manufacturer of tobacco, and, to a few enlightened people, by his princely gifts to M'Gill University, Montreal. He has made his money out of tobacco, but—perhaps on the principle of the boy who never ate marmalade because he worked where they made it—never smokes. For over forty years he has been a resident of Montreal, and has given largely of his time, thought, and wealth to the advancement of education in Canada; and these gifts have always been bestowed with the greatest judgment, being directed towards leading the people to the acquirement of knowledge, ability, and wisdom, and at the same time providing opportunities whereby they are enabled to do so successfully. An idea of the magnitude and cost of the enlarged plan may be formed when it is remembered that teachers capable of introducing the new subject were not to be found within the limits of the country itself, thus necessitating bringing them from abroad, the expenses being borne in every case by the fund. The schools have in every case been liberally staffed. In many cases the instructors were married men, and the expenses of their wives and families were paid. A director or superintendent was appointed for every province, located generally in the capital, and to him was committed the general organisation of the work. At first we were rather shorthanded, but as rapidly as men could be secured this difficulty was overcome. Teachers were drawn from Leicester, Leeds, Bradford, West Ham, Manchester, Bristol, London, Wood Green, Carnarvon, Oldham; and Canadian teachers were trained as speedily as possible.

In each province the director is responsible for the actual course or system of models that is adopted; and I am thankful to say that, up to the present, along with English teachers we have not imported the battle of the "systems." We are prepared to recognise that every system has been devised with one end in view—the greatest educational good to the child; and when all have the same goal in view, it seems to be the greatest folly to fight over the road by which we travel to reach it. The points on which we agree are immeasurably greater and of more importance than



SIR WILLIAM C. MACDONALD.

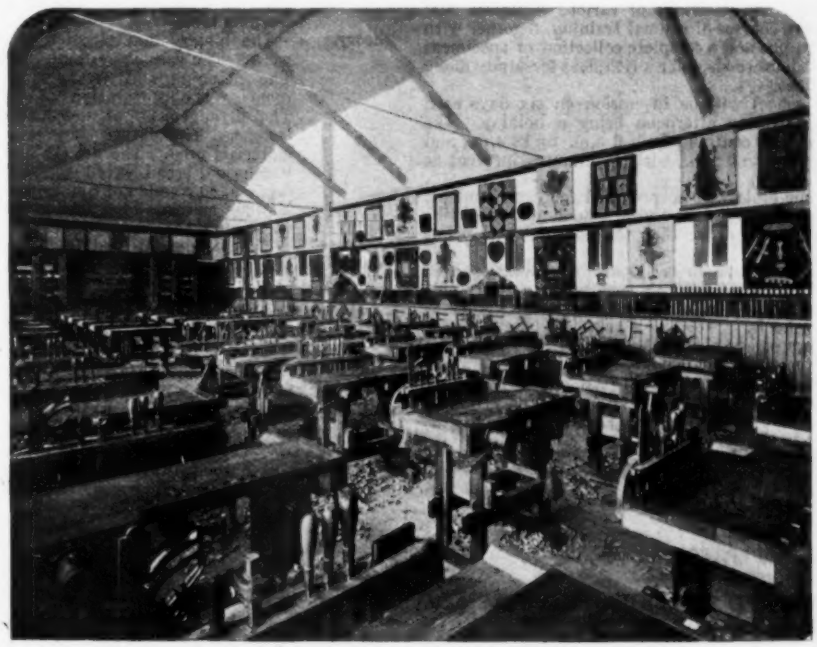
those over which we differ, and the former should be accentuated and not the latter. The "centre" system is the one that has been generally adopted, though in some

BRITISH MUSEUM

of the larger towns it has come to be recognised that the best way of carrying on the work is by establishing a room in connection with each separate school. The centre system has always had many disadvantages; indeed, the only advantage that can be seriously claimed for it is that of economy. On leaving the school premises the boys and girls seem to acquire the idea that they are going to take part in something which is not part of their school life, and the connection that should always exist between manual training and other school subjects is materially weakened. The instructor is under great disadvantages from the fact that half a day per week is scarcely enough in which to acquire a full knowledge of the individual character of the boy. The success of all true educational effort is measured by the extent of this knowledge of the character of the individual, regarded separately, and not as forming a unit in a class. Whether the time will ever come when the class teacher will be competent to take manual training with his other subjects is difficult to say, but, in my opinion, it is a consummation devoutly to be wished.

Now as to the style of the rooms in which the work is carried on. In the vast majority of cases the centres are almost ideal in character; and in the one or two instances where rather unsuitable rooms were the only ones available, no expense was spared to make them efficient. We in England never seemed to pay much attention to the environment of the children, and outside a few notable exceptions —notably Leeds—the typical manual-training room was as unlovely and barnlike a place as we could possibly make it. Here we have proceeded on somewhat different lines. We believe, and believe strongly, that the influence of the place in which a boy or girl works has a great influence, inspiring or otherwise, on both the character of the boy and the results of the work; and in conformity with this idea we have sought to make our manual-training rooms as bright and attractive as possible, and have devoted special attention to their decoration, though everything that has not a direct bearing on the work has been rigidly excluded. Specimens of timber, sections of trees, examples of work, photographs of trees both in winter and summer, pictures of lumbering operations, etc., have been liberally supplied. The actual course of models being taken is displayed by means of large drawings round the room. These are very effectively and economically prepared in white chalk on ordinary wall-paper. Every tool in use has been taken apart, the separated parts being mounted and properly named; and it is surprising what an effect illustrations of the kind above referred to have in stimulating a healthy curiosity in the minds of the boys. A view of a typical room is shown.

Soon after the work got well under way, it was felt that a great hindrance to its future development would be the dearth of teachers, and steps were at once taken to supply this deficiency. It was decided to establish training schools in two provinces, in order to equip Canadian teachers. The provinces selected were Ontario and Nova Scotia, Ottawa and Truro being the towns. The educational authorities offered every inducement to teachers to take a six months' course with this object in view, those in Ontario being offered a bonus of 120 dollars, with tuition and use of tools and material free of all cost to themselves. Though our experience has almost led us to the conclusion that even this length of time is scarcely sufficient, it is not advisable, for many reasons, to lengthen it; and it must be remembered that the time spent is nearly equal to twice the time spent in preparation for the certificate of the City and Guilds of London, the Institute at Nääs, and the Training School at Leipzig all rolled into one. In order that the best men out of a large number of applicants might be chosen, the director for Ontario took a two weeks' trip through the province, interviewing the candidates, and making a selection; for it is believed that manual training stands or falls with the character of its representative. By this means a number of good men were obtained, amongst them being several university graduates. Fifteen took the course in Ottawa, and nine in Truro. It will probably interest English teachers to peruse the syllabus relating to this course. In addition to the work set out, each student took a course in cardboard consisting of sixty models.



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Cardboard. An extra class in cardboard modelling will be formed for those students who wish to study this form of manual training for the primary grades of public schools.

Fees. No fees will be charged for tuition, materials, and use of tools.

Further Information. Intending students should read carefully the conditions as set forth in the accompanying syllabus, fill up the form of application as directed, and forward it to the undersigned, from whom further information may be obtained.

ALBERT H. LEAKE,
Director of Manual Training for Ontario,
OTTAWA.

Approved
JAS. W. ROBERTSON.

PARTICULARS AND SYLLABUS OF SPECIAL TRAINING COURSE FOR TEACHERS OF MANUAL TRAINING IN WOODWORK.

Qualifications for Admission. Students to have received normal school training, or to produce satisfactory evidence of at least one year of experience in successful teaching. Age to be not under twenty years, and evidence as to good character and general fitness for training to be furnished.

Students will be received on probation. The faculty of the school reserve the right to advise any student who may show little aptitude for the work to discontinue the course.

Duration of Course. The course will commence in January, and continue for a period of six months.

Scope of the Work. The work will consist of:—

1. **Drawing.**
2. **Bench Work.**
3. **Theory.**
4. **Observation and Practice Teaching.**

Drawing. (*a*) **Freehand.** Simple drawing of ornament from the flat and from casts. Elementary shading from the cast. Drawing of objects, involving the rules of perspective. Sketching of leaves, details of seed, fruit, etc., timber trees from natural forms, tools and their construction. Blackboard drawing for demonstration purposes.

(*b*) **Mechanical Drawing.** Orthographic or right-lined projection; descriptive or practical geometry as contained in the authorised text-books; scale drawing by standard and metric measurement; isometric and conventional drawing. The representation by one or more of these methods, or a combination of them, of every piece of work performed at the bench.

Bench Work. The working of a series of models or exercises in wood graduated to form an educational course suitable for three years' work in public schools.

The making of at least six of these models, to show for teaching purposes the sequence of the various operations. The making of a selection of models from the leading courses of Europe and America. The construction of joints commonly used by woodworkers, including the various forms of halving, mortising, dovetailing, scarfing, etc. The designing and making of original models in place of any specified models in the graduated scheme. On the completion of the course the models made will become the property of the student. The benchwork will include the use of various woods, glue, nails, screws, etc., and all the principal woodworking tools.

Theory. The history and practice of educational woodwork. The various systems. School management. The planning and arranging of manual-training rooms. The preparation of "notes of lessons." The arrangement of demonstration and object lessons. The nature and properties of various materials used. The growth and structure of coniferous and broad-leaved trees. The felling, seasoning, and conversion of timber, its faults and defects. Various methods of finishing wood, as shellacking, varnishing, etc.

Observation and Practice. The Macdonald Training Schools of the district will be open to the students for observation and practice. During the latter half of the course students will be required to spend some portion of each week in actual teaching under the observation, and subject to the criticism, of the faculty of the school.

Scope of the Examination. At the end of the course an examination will be held to discover the student's ability in each of the foregoing branches.

1. Tests will be made of the student's knowledge of projection and its practical application to woodwork, also his ability to draw from memory portions of tools, leaves of trees, etc. Time, 4 hours.
2. A practical examination in benchwork will be conducted to test the student's skill in the use of tools, and his general methods of working. This will be conducted by special examiners appointed by the Board of Examiners. An examination will be made of the student's knowledge of the various woods, and of his ability to identify actual specimens. Time, 4 hours.
3. A written examination in the history and practice of educational woodwork and cognate subjects. Time, 3 hours.
4. "Notes of lessons" on the different subjects of the course to be prepared and submitted to the examiners, who will choose one or more to be given in their presence as a test of the student's ability to teach and manage a class. For this purpose classes of not more than sixteen pupils will be allotted to each student.

Satisfactory work during the training course, combined with success at the examination, will constitute the basis on which diplomas will be awarded.

In addition, holiday courses have been held in most of the provinces. The first course held in Ontario was attended by eight students, the second by over eighty, and the third year it was necessary to hold them in two places—Ottawa and Toronto—the number of applicants being doubled. At these, special attention was paid to acquiring information about trees at first hand, lectures by experts having been delivered in the woods. Each student has been required to make an original model as some contribution to such a

course of models as would be typical of the country and its requirements. The part that these students have taken in spreading a knowledge of the new subject cannot be overestimated. Each on his return acts as a missionary, and many of them are now engaged in applying manual-training methods in their own schools.

Teachers the world over have too long looked upon manual training as a subject of instruction, and that only. It is something more than that—it is a method, and a method which can be applied to every subject in the school curriculum, and as such it is slowly but surely coming to be regarded. Every chief centre in the Dominion is provided with a small but comprehensive library, consisting of about fifty books, dealing with the subject from all points of view. Besides the actual organisation in the various provinces, it has been part of the duty of each superintendent to stimulate public interest by attending conventions of teachers, and addressing the various School Boards seeking information on the subject, and the demand for their services in this connection has been very great. In each county the teachers are by law compelled to hold a two days' convention, at which to discuss subjects and methods of instruction; and practically every town of any size and importance in the Dominion is eager for information regarding the new subject, and how it can be carried on. As an instance of what has been done in this connection, it may be mentioned that the director for Ontario has travelled more than ten thousand miles. In Ontario and Quebec the more important towns are blessed, or cursed, with three School Boards—High School, Public School (Protestant), and Separate School (Catholic); and a law has lately been passed in Ontario making it legal for the three to appoint a joint-committee, in order that manual training may be carried on efficiently and economically.

As befits this country of illimitable extent and resources, manual training has a somewhat wider meaning than in the old country. It reaches deeper and climbs higher than is usually the case in England, and includes kindergarten, all kinds of handwork, nature study, household science. It is recognised perhaps more fully that its real beginning is in the kindergarten, and the towns that are adopting the subject are commencing at the bottom and building up. Looked at from a strictly English point of view, which is apt, perhaps, to be rather narrow and insular on this question, manual training in its higher forms seems to trench somewhat on what is known as technical education; but here the line of division is not so sharply defined, and indeed what in England is understood by manual training often goes under the name of elementary technical education. Canadian practice is largely influenced by the schools of the United States, which have very largely developed this higher aspect. It may not be considered presumptuous on my part to offer a word of advice to the English teacher in love with his subject and enthusiastic over its possibilities and mission. In England only the fringe of the subject has been touched. I have before me, as I write, four large volumes, consisting in all of 4,210 closely-printed pages, on this subject—pages absolutely teeming with information and investigation—published by the Bureau of Education, Washington. The Forestry Department also publishes many useful bulletins on forestry, timber, etc., which are especially useful to the manual-training teacher. The best and clearest book I know on the growth of timber and its characteristics is published by this department at a cost of ten cents. Many of the American School Boards also publish books on manual training: that issued by the Chicago Board is a volume of three hundred pages, and is full of information. To the English teacher who is tired of the never-ending books dealing with systems and courses, and who desires new inspiration and fresh light, I would say, devote your attention to what is being thought and done and written in the United States of America. Much pioneer work has been done by the publication of pamphlets containing addresses delivered at various conventions. The newspapers have rendered the greatest assistance to the spread of the work, publishing long articles descriptive of each school as it was opened, many of them being beautifully illustrated—a specimen of which I have sent to the office of THE PRACTICAL TEACHER, where it may be seen by any interested. Mr. P. L. Gray has lately made a tour of our country, and visited a large number of schools. In each place he has addressed public meetings, and done not a little towards spreading right ideas of our work and of its immense possibilities. Manual training is being put into every normal school in the Dominion, so that the time is not far distant when every teacher trained in the country will have as part of his regular equipment the ability to intelligently conduct classes in the subject. Many of the schools have been formally opened by their Excellencies Lord and Lady Minto, who have from the inception of the movement taken the greatest interest in its progress. Their eldest son, Lord Melgund, was for the whole time he was in Canada a regular attendant at one of the public school classes. The equipment provided is of the best, and each pupil is provided with a separate locker in which to store his drawing, etc. The centres are equipped for twenty or forty, though one large centre was fitted for sixty. This was rendered necessary in Ottawa, owing to the large teachers' classes that had to be handled.

The teachers who were brought from the old country have almost without exception done good and useful work, adapting themselves readily to new conditions, and fitting in with their new surroundings. The conditions of school life here are in many respects different from those at home. The greatest difference of all is perhaps in what the English teacher understands by the word discipline. At first sight he would be inclined to say that it is conspicuous by its absence, but on investigation and reflection would considerably modify this hasty judgment. The relations existing between teacher and taught are of a different kind—altogether freer and more open; and when once the difference is recognised and understood, the change is a pleasant one. A lad will not hesitate to give his opinion and his reasons for it, and is not at all inclined to take the teacher's judgment unless he is himself convinced of its reason. There is an air of freedom and independence that is totally lacking in these relations in English schools. I cannot here enter into the causes for this, but simply note the fact, and content myself with saying that in my opinion it helps materially to more effective educational work.

Before the inauguration of the manual-training schools proper, Sir William had given a sum of 10,000 dollars to provide prizes for boys and girls in a seed-grain competition, carried out in accordance with the recommendation of the Royal Commission in that section of their report referring to school gardens. The progressive agriculture branch of the fund has great possibilities of usefulness before it. Over two thousand boys and girls have entered the competition, and there is no saying to what heights its educational influence may grow. The work under the fund is not the only manual training that is carried on in the Dominion. Many educational authorities, inspired and instigated by the success of these schools, have established this form of instruction on their own account, and in a number of instances have erected a building in which manual training and household science can be carried on under the same roof. In these cases liberal aid is given by the provincial governments. The amount of this grant in the majority of cases depends upon the peculiar circumstances of each place, but regulations are being laid down in order to award the grant on some definite fixed basis. The province that has advanced farthest in this direction is perhaps Nova Scotia, under the superintendence of Mr. T. B. Kidner, late of Bristol. A specially excellent feature of the school law of this province is that no rural school can be graded as superior (first class) unless it has a workbench and a full set of tools.

So much for the past, but what of the future. In June of this year the control of the fund ends, and it is confidently hoped that those localities that have had a school will take up the matter for themselves, and continue the work that has been going on for the past three years. In these cases the equipment will probably be presented to the School Boards determining to continue the instruction. The director in each province will probably be taken over by the Education Departments, and appointed supervisor or inspector.

This has already been done in the Province of Ontario. Though the engagement entered into with each teacher only provides for a period of three years, there is not the slightest doubt that congenial situations on a permanent basis will be found for every instructor who entered into those agreements.

Having given these object lessons to the larger centres, the next efforts of the fund will be directed to the improvement of education in the rural schools. The plan proposed is a comprehensive one, and may be conveniently divided into four parts, as follows:—

"**Part 1 of the Plan** is intended to give object lessons of improvements in education from the consolidation of five, six, or more small rural schools into one central graded school, with a school garden and a manual-training room as part of its equipment.

"It is proposed to offer financial assistance to one locality in Ontario and one locality in each of the Provinces of Quebec, New Brunswick, Nova Scotia, and Prince Edward Island, to induce the people to undertake and carry on object lessons of improvements in education, with school gardens and manual training, all under the control of the regularly-constituted educational authorities.

"**Part 2 of the Plan** is for the purpose of giving object lessons on the value of school gardens and nature studies, at individual rural schools, as a part of general education, to be begun by means of a travelling instructor, who would visit and spend one half-day per week with the children and teacher at each school of a group, for a term of three years, or until a considerable number of suitably-trained and qualified teachers would be available to carry on such work themselves at rural schools.

"It is proposed to offer financial assistance to one group of ten or fewer schools in one locality in Ontario, and to one group in each of the provinces of Quebec, New Brunswick, Nova Scotia, and Prince Edward Island, to enable the people to provide school gardens, and to undertake and carry on object lessons and experiments with improvements in education, all under the control of the regularly-constituted educational authorities.

"**Part 3 of the Plan** has for its object to assist in providing short courses of instruction and training for teachers for rural schools who desire to qualify themselves in these newer subjects and methods of education.

"It is proposed to offer to the Province of Ontario, at the Ontario Agricultural College at Guelph, a gift of a building, including a nature-study plant-growing house, and such equipment as may be required, in addition to what is there at present, for the accommodation of teachers while taking short courses in nature study for rural schools.

"**Part 4 of the Plan** is intended to assist in providing courses of instruction and training in domestic economy or household science for young women from country homes, in order that they may have opportunities for acquiring practical and advanced education not less suitable and helpful to them than the present courses at the Ontario Agricultural College are beneficial to young men, who take them with earnestness and cheerfulness.

"It is proposed to offer to the Province of Ontario, at the Ontario Agricultural College at Guelph, (1) a residence building to accommodate not less than one hundred female students and teacher-students, daughters of farmers and others; and (2) classrooms, kitchen laboratories, and other equipment necessary for courses of instruction and training in domestic economy or household science."

The building to be erected at Guelph will be the most complete and the best equipped on this or any other continent. The Agricultural College at Guelph is a most magnificent institution, and receives students from every part of the world; and with the addition of this new building, which has already been commenced, the institution will be completed and perfected in its organisation.

Such are the plans and projects of the Macdonald Manual Training Fund under the direction of Professor Robertson. Only the barest outline of them has been possible within the limits of this short article; and I shall not attempt to say to whom the greater honour belongs—to the man who by his ability to plan, power to overcome obstacles, and energy to direct, or to the man who, by his generosity and wisdom in spending his wealth, makes it possible to bring those plans within the realms of the practical.

BY MANY HANDS.

"Quot homines, tot sententiæ."

BY way of *pointing* a lesson on thrift and prudence, French scholars have been treated to the following little homily by a contemporary. "All our pins come from England. Last year they made no less than 280 millions of them. And yet, when a pin is wanted, one is never to be found! Now, out of every hundred pins sold, only one is really worn out or broken. The other ninety and nine are mislaid, so that we lose every year some six millions of francs' worth of pins, or about fifteen centimes' worth for every person in the country!"

That Pin!

An excellent little sermon, full of *point*, and impressing facts of commercial geography at the same time as it inculcates care in the management of the maternal pins. But what we want to know is, What becomes of all those ninety and nine wandering pins? Is it possible that only one per cent. of this product of one of our industries finds somewhere to stick? Matches, we know, are often enough fleering delusions, headless bodies that will strike neither on nor off the box, and imagination boggles at the contemplation of the number of them that are born to mock the luckless light-seeker. But a pin, with a well-shaped head to direct, and a point to find its place! Something must be wrong with pin-nature for ninety-nine per cent of them to go a-vagabonding.

* * *

RESEARCHES into the nature and effects of fatigue in school life have occupied physiologists and psychologists in recent years. A Swedish educational commission has been investigating a kindred subject—the amount of sleep necessary for children of various ages. The announcement that "scholars who do not take the average amount of sleep have twenty-five per cent. more of illness than others" sounds pompous and oracular. One instinctively asks, What is the average amount of sleep? The commission considerately prepared for the question, and thus filled up the blank:—

How Long to Sleep.

For children of 4 years.....	12 hours.
For children of 7 years.....	11 hours.
For children of 9 years.....	10 hours.
For children from 12 to 14 years.....	9–10 hours.
For youths from 14 to 21 years.....	8–9 hours.

This does not exactly square with the old English saw, that of sleep the requisite number of hours could be settled by the following simple rule:—Six for a man, seven for a woman, and eight for a fool. To which most of us will reply, We have no scruples about taking the fool's portion. Now if we accept Mr. Carlyle's dictum as to the mental status of the average inhabitant of the British Isles, we shall see that we have thus almost exactly hit upon the dose of slumber recommended for the adult by the Swedish Commission.

* * *

WHAT a part that little prefix "anti" plays in the social development of the age. No sooner does

a craze or a custom establish itself than its *anti*dote is provided in the shape of a society with an "anti"-label, existing only to run down and exterminate the aforesaid custom or craze. The Law of the Excluded Middle, dear to us all in the days when we disported with Jevons's Logic—everything must either be or not be—will soon be capable of expression in terms of social institutions, as thus, "every one must either be something or anti-something." Indeed, a witty Frenchman suggested some time ago that a society should be formed, called "The Anti," whose members should be against everything that had labelled itself anti-something, a very Ishmael among societies. But the "anti" has now descended into the schools. In one form or another all great movements have their roots in the primary school, where the national mind is in the making. And so there is much propriety in the connection between the primary school and the crusades going on in various countries against alcoholism and tuberculosis. A sound instruction in the laws of physiology and hygiene as bearing on these two scourges will do much towards slowly preparing the day of better things. For example, a clear knowledge of the dangers of promiscuous expectoration will help to destroy what is at one and the same time a filthy habit and a common peril; just as a comprehension of the dangers of the dry sweeping and dusting of rooms and roads will also help in the same direction. In this sense the "anti" in the schoolroom is a real gain. Success to instruction of this kind, even though labelled anti-alcoholic or anti-tuberculous!

The "Anti" in the Schoolroom.

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THE *Pennsylvania School Journal* generally contains some refreshing items of information, but we wonder whether it is serious in the following statement about Admiral Schley and the battle of Santiago. After the Spanish-American war, the disputes which arose as to the honour of victory between the two American admirals commanding the fleet will be easily remembered. The States which were the respective birthplaces of the admirals naturally stood up for the claim of their respective children. But now, according to the *Pennsylvania School Journal*, Louisiana, the State which claims Admiral Schley as its child, has interdicted the use in schools of any books which do not attribute the victory to the Louisianian admiral! This is a novel way of writing and teaching national history. Better, far better, to pass over in silence any such disputed points than to risk arousing a feeling of distrust in the story of one's country. Besides, such a proceeding is open to retaliation. Other States might refuse to authorise books in which the honour was accorded to Louisiana, and then what a sublime spectacle would be presented. There is sufficient folly in the world without starting out to increase the stock of it by means of text-books on history.

The Admiral and the History-book.

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REPLYING recently to a relative who inquired how best to educate his children, Tolstoi gave some of his ideas on the subject in a long letter. "Teach children as little as possible," said he; "the danger being less for children to be ignorant of many things than to be falsely or superficially informed." And to the question, natural enough, whether children should then be allowed to remain idle, he replied, "No! And never let them think that all their wants must be satisfied without their sharing in the labour that goes on around them." They should be taught at an early age to wait on themselves, to perform all necessary functions in the home—in a word, be taught to be usefully independent. As they are naturally imitative of their elders, parents, said Tolstoi, should also perform all these necessary domestic and social functions as a model. Otherwise, said the veteran Russian apostle, children will conclude that men are divided into two classes—masters and servants—from seeing others do for them what they could do for themselves. And then, away go your efforts at moral education. Fraternity and sympathy will be nothing but empty terms, contradicted at every moment by what the children see around them.

Tolstoi on Education.

There is a grand simplicity in these ideas of Tolstoi. Teach only the real, the true, even though you teach but little. Train to be useful and self-reliant, and to lead such a life that the teachings of morality may be reconciled with daily actions and feelings. Such an educational creed is not complicated, but its very simplicity has a certain grandeur in it.

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WHAT'S in a name? Well, if the advertisement of a new book which lies before us is to be trusted, everything lies in a name. The *Mysteries of Sound and Number*, by a gentleman rejoicing in a weird Asiatic appellation, is concerned, we are informed, with "an extraordinary law governing a great many transactions in life hitherto regarded as the sport of chance." This law has to do with "the numerical value of sounds," and those "who appreciate its significance" will be introduced "to entirely new views of the hidden forces and powers operative on the affairs of this world."

Names and Numbers.

Abracadabra, the Philosophers' Stone, the Rosy Cross, and all black and white magic together, sink into nothingness compared with this. If the issue of events where competition, struggle, or contest is involved is to be foretold by the mere pronouncing of a name, and subtly calculating the value of the sounds employed, then the occult sciences have been indeed supplanted by the Sheikh Habeeb Ahmad, the author of the book thus entrancingly described. Could we but apply the secret to the Education Bill for London, or even to the Education Act of the year just gone, how happy we should feel. For these things are sure to involve "competition, struggle, contest," just the very indispensables for the action of the law of the numerical value of sounds. Curiosities often find their way to our writing-table, but seldom anything so curious as this notice of a book, containing a chapter on "Planetary Sounds," and an appendix on "Glaring instances of the Names beginning with the Sounds belonging to the same Planets [*sic*] being placed first, second, and third, or first and second." It sounds so very Abracadabra-ish; but perhaps if we whisper the words, "The Turf," the meaning may seem less obscure.

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THE ways of children's ideas are past finding out, as every teacher knows to his cost, and mysterious productions result when they try to express those ideas in words. There is some confusion of ideas in the description of the process of evolution given by a boy, who said, "Human beings ceased to walk on all four, and walked on the hindmost;" but the following description of the

Incomprehensibles.

conflict between Carthage and Rome betrays only a confusion in the means of expression. "Hannibal," said he, "stood with one foot in Spain, while with the other he beckoned to the troops." One sees in this the idea the boy is striving to express, though we frankly confess that often enough the mental workings of the average boy remind us of nothing so forcibly as of Bishop How's description of a certain clergyman as "invisible for six days of the week, and incomprehensible on the seventh." There is a fine confusion in the derivation of pontifex, as given by a youngster: "It is derived from *pons* a bridge, and means the chief priest, just as we say *arch*bishop." But the palm for directness and wrong-headedness combined must be given to the answer to the question, "Explain the meaning of a bishop, priest, and deacon." One boy replied, "I never saw a bishop, so I don't know. A priest is a man in the Old Testament. A deacon is a thing you pile up on the top of a hill and set fire to it." For all our efforts at child study, the mental processes of the ordinary youngster are a sad puzzle to us yet.

* * *

THE Rhodes scholarships at Oxford and their possible effects have produced their first "skit." Mr. George Calderon has given to the world a lively booklet, presenting the adventures of the grandson of our old friend Verdant Green during his first term at Oxford. Mr. Downy Verdant Green is the son of one of the sons of the hero of Mr. Cuthbert Bede's book, who had settled in the United States and become a wealthy soap-boiler. The first name of Downy is taken from the hero's maternal grandfather, a Mr. Downy, typically American, who serves as a foil to the more stolid character of the father. Downy V. Green, having exhausted the educational resources of soap-boiling Lavinia, his birthplace, is a candidate for a Rhodes scholarship at Oxford through the representations of Mr. Downy. He succeeds in gaining one, and immediately sets to work under the tuition of his grandfather Downy to master the history of Verdant Green at Oxford, since the old man declares that the Britishers never change anything, good or bad; and he is convinced that if Downy, the grandson, should imitate the doings of his Verdant ancestor, he will exactly follow Oxford traditions, and worthily uphold the honour of Lavinia and of the Star-spangled banner. Once arrived at Oxford, he tries to follow out this plan of campaign, and those who are familiar with the vagaries of Mr. Verdant Green will readily imagine the wildly farcical doings that result.

Verdant Green Redivivus.

* * *

INCIDENTALLY the reader is introduced to another Rhodes scholar, also an American, whose father, mother, and sister have all accompanied him to Oxford to help him to spend his £300 a year, and to educate themselves *and* the university. The style of the book is naturally illustrated with American slang—slang of a startling type. Some of it is quite unintelligible, but some of it is astonishing from the penetrating way in which it goes to the heart of the things it describes, though always from some absurd and incongruous point of view. There are thumb-nail caricatures of the usual 'Varsity types and of 'Varsity social institutions. Two Continental types, a Russian and a Frenchman, come and go across the skittish blunders of Mr. Downy Verdant Green and his fellow Rhodes scholar. The Russian is convinced that training for rowing is only the cloak of some great secret political society, and a "bump" supper convinces him that the revolution he has imagined has at last arrived. On the subject of rowing and the use of a "cox," the American lady is vastly amusing; and to balance this perfervid lady a "College" beauty, a type somewhat resembling Kipling's "Venus Annodomini," is introduced. It is a lively production, quite short, but crammed with sufficient incident, slang, and caricature to have filled a bigger book. This is the first of the Rhodes scholarship literature we have seen, but we fear it will not be the last.

A Downy American.

* * *

THE following tit-bit comes from the provinces. A certain Wessex country school was duly examined by the diocesan inspector. He was an amiable old gentleman, the vicar of a neighbouring parish. He put the children through the usual routine—oral and written. In course of time the report came to hand. Its recipient, the rector, perused it with great interest. The inspector's handwriting was notoriously bad. The rector could not make it out. "He never was very clear," said he, and passed it to his wife. She regarded it critically through her pince-nez. She could not decipher the writing. So the rector marched off to the school. "Can you read it?" he asked the master. Between the two of them they spelt out the main of it, but one sentence defied their efforts. "It is worse than hieroglyphic," said the rector. "I'll write and ask him to explain." He sent the report back accordingly. In due course it was returned, with the interpretation thereof. This is how the obscure sentence ran: "*It would be better if the writing of the first class were more legible.*"

Physician, Heal Thyself.

* * *

BACHELORS will be interested to know that at the Chelsea Polytechnic the authorities have taken in hand the question of "wife-training." A regular scheme of instruction has been in operation there for more than a year, and, according to all accounts, the results are quite encouraging. The object seems to be not so much to instruct the Chelsea maidens how to marry, as to give them some practical training in those manifold duties of housekeeping that devolve upon the young wife. One often hears, from those who ought to know, of the troubles and anxieties that generally accompany the first few years of married life. The unprincipled tradesman, the aggravating "maid-of-all-work," the encroaching charwoman, the chimney-sweep, the cadger, the butcher's boy, all find out the new and inexperienced wife, and lead her a sad life. She has been their prey from time immemorial, to the destruction of peace around the domestic hearth. Now, thanks to Professor Tomlinson, she may forestall these things, and for the modest sum of £15 a year may fortify herself against the day of their coming. Chelsea young men will rejoice to find that the enterprise is being taken up so well. Half a hundred young women are already upon the books, of an average age of eighteen years. One would hardly be surprised to hear that even confirmed bachelors were drifting Chelsea-wards.

Wife-Training.

* * *

PRIZE-GIVING assumes enormous proportions in some quarters, and becomes almost an absurdity. But the climax was reached, surely, in a kindergarten

prize distribution described recently by a French primary school inspector. The proceedings of a public school prize distribution were parodied in dramatic dialogues, monologues, and songs by miniature performers of five years old. A long list of prize-winners was read out by the headmistress, during which tiny toddlers were called up to receive volumes as rewards for excellence, for spelling, for languages, *prix d'honneur*. The crowning moment came when a mite of two years old or thereabouts was *led* up to receive the prize for *civics!* Our colleague, the inspector, says: "Surely this must have been a budding Washington; but what a travesty such a distribution is, and how hard it is for some people to break away from false but dearly-beloved traditions!" The description sounds like a comic invention, but it is gravely reported in a reputable pedagogical journal of the other side of the Channel. What *would* Fröbel have said?

A Reductio ad Absurdum.

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WAS it not Matthew Arnold who, in one of his inspectorial tours, cried out in horror at a young Devonian that he could not speak his own language, because the boy used some of his native Devonian words, and ended by calling a wasp an "apple-drayne"? What would he have said to the suggestion of a French inspector, who bears a well-known name, that teachers in elementary schools in France should study the *patois* of their district, and employ their knowledge in making their pupils understand the meaning of terms in ordinary French? To him it would have seemed like tampering with the accursed thing. And yet there is something to be said for the suggestion. Some of the *patois*, especially in the southern parts of France, contain words which are nearer to the grandmother of French—Latin—than their synonyms in the more widely-accepted tongue. From a knowledge of them the meaning of composed or derived terms can more easily be comprehended, and so the comparative study of the *patois* would really be a gain to the teacher. Note, however, that it should be *study* not *use*. We are less blessed (or *should* it be cursed?) in England in this matter of *patois;* and yet all who try to make the study of their mother tongue interesting and fruitful to youngsters from ten to fifteen years old, must have felt the help that comes from a knowledge of the different dialectical forms still existing, and this knowledge can, as the French inspector suggests, be gained at first hand.

Patois in the School.

❧ WITH OUR CHILDREN. ❧

THE eighth annual report of the London Branch of the British Child-Study Association has been issued, and is a testimony to the general vitality of that organisation. Besides the necessary lists of officials, the season's programme, rules, and the like, there is a reprint of the presidential address by Dr. Fletcher Beach, already noticed in this column; and in addition there is a feature which will be of both interest and service—a full list of the members, with addresses. We note that in a fit of "absent-mindedness" the compilers seem to have forgotten the name of their association, which is designated "the London Child-Study Association;" but this, we are informed, is simply due to an oversight. The same cause is doubtless responsible for the description of the B.C.S.A. as the "parent" organisation. We cannot imagine a better stimulus to the smaller branches than the sight of this report, which is so eloquent of activity and enthusiasm.

A Hardy Annual.

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DR. KIMMINS, in his recent lecture at the Sesame Club, made out a strong case in favour of trained investigators for research in child study. This is our most urgent need. We have already thoroughly-equipped investigators in various *departments* of the subject—specialists in physiology, nervous disorders, training of the weak-minded, and so on; but we need to have the results of those special studies correlated, and we need also specialist investigators in other departments which have been hitherto left to the well-meaning but not well-equipped amateur. Now that the necessity for organised research is being admitted in such quarters, it is not too much to expect, surely, that in the metropolis at least, if not elsewhere, we may see established some department, of university status, where the teacher can be trained to study the raw material of his craft, and where reliable information may be amassed for the service of all.

Trained Observers.

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LONDON has surely a unique opportunity at the present moment of leading the way in this direction. In many American training colleges the systematic study of children is regarded as an essential part of the teacher's training. The new Professor of Education, Mr. Adams, is qualified as few men are to direct students in this special study, and he has by his writings "and otherwise" shown his sense of its importance. Every member of the B.C.S.A., and many who are not members, will watch anxiously to see whether tradition or common sense will prevail in the new curriculum; for in our "effete monarchy" there is at least one force which shows undiminished vigour, and that is conservative tradition. If it is to yield to reason anywhere, it should surely be in the training of the teacher, who is himself destined to play the part of iconoclast towards many traditions in his life-work.

London's Opportunity.

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THE members of the College of Preceptors listened to sound doctrine from the Rev. J. O. Bevan at their November meeting, when he included in "the equipment of the teacher" a very adequate proportion of child study. We hope the doctrine was not regarded as heretical by any of his hearers. We take the liberty of quoting a few sentences:—

At the College of Preceptors.

"It is stated that the elements of the body are completely changed in every cycle of seven years, but it is frequently forgotten that a similar law operates in regard to the elements of the mind. Yet, in both cases, we are scarcely conscious of the change. Thus there often yawns a great gulf even between the young teacher and the child he sets himself to instruct. In what degree formal training would lead to the bridging of this chasm it is difficult to say. It is said above, 'the young teacher,' for frequently it is only when one advances in years that one becomes a child again. It may be that this is partly owing to our becoming parents ourselves, and being thus brought into personal and sympathetic relation to young children. Otherwise, it may be due to the growth of tolerance and larger forgiveness which come with lengthening years, and partly also to the greater difference in time between us and our scholars, so that we can the more easily afford to unbend.

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"It may well be contended that our primal requisite, as teachers, is to *know ourselves*—our strength, our knowledge, and our limitations in respect of both, and in our expression of them.

The second great requisite is an acquaintance with the child—its faculties of body and mind, and, indeed, with its whole nature. We should know the leading facts concerning the structure of the body—that is, the body as an animated machine, governed by the laws of mechanics, measure, and avoirdupois; the bony framework, the shape of the constituent parts, their composition, manner of growth, and interlocking movements; the muscles, their attachment, mode of action, variation in size, waste, replenishment; the nervous system, its response to impulses from within and from without, its automatic and its conscious exercise; the digestive system, assimilation, nutrition, the character and variation of the teeth; the senses, their limits of activity and preservation in perfect and painless use. Further, in relation to those under our charge, we should study the laws of growth; the mysteries of direct and reflex action, the telegraphy of the senses; the avenues of knowledge in respect of sight, hearing, tactile movements; the signs and symptoms of simple ailments and infectious disorders; the dangers to be looked for and overcome in regard to possible accident; the laws of brain growth, signs of brain disturbance, fatigue, torpor, excitement, hysteria, chorea. In thought, we should follow our charges even to their cots at night. The other day I met with a little maid of four, who was discovered by her mother, night after night, excitedly talking to her dolls about her lessons, and worrying them, under the impression that they were her schoolmates. Such a case should immediately be dealt with, and shunted off to more natural fields of activity."

If we add to these counsels still others which were included in the address, bearing on hygiene, the playground, and the boarding-house, we may gather that the lecturer recommended to his audience a fairly catholic course of child-study.

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Lectures in Connection with the London Child-Study Association.

THE following lectures in connection with the London Child-Study Association will be held at the Offices of the School Board for London, Victoria Embankment, W.C., at 8 p.m:—

Friday, February 13, Professor W. D. Halliburton, M.D., F.R.S., Professor of Physiology in King's College, on "Physiology in Relation to Child Study."

Friday, March 13, Professor J. Adams, M.A., Professor of Education in the University of London, and Principal of the London Day Training College, on "Some Aspects of Child Study."

Friday, April 3, Professor W. A. S. Hewins, M.A., Director of the London School of Economics and Political Science, on "How to use Statistics in Child Study."

Further information may be obtained from Miss Kate Stevens, Hon. Secretary of the London Child-Study Association, Carlisle House, Dartmouth Park-hill, N.W.

N.U.T. NOTES.

At Glasgow.

PROBABLY, by now, I am qualified to speak of myself as an "old Conference hand;" for, in addition to being present at every N.U.T. and N.F.A.T. Conference since 1891, I have attended, in a representative capacity, educational meetings at Amsterdam, Arnhem, The Hague, Mons, Namur, Limerick, Edinburgh, and Glasgow. On the last Saturday of the year I set out for Scotland's commercial capital, my mission being to represent the N.U.T. at the twenty-ninth Annual Congress of the Educational Institute of Scotland, which (as everybody perhaps knows) was "incorporated by Royal Charter, 1851." *En route*, I picked up Mr. Harry Coward, the Union's able and esteemed vice-president, who proved to be a singularly agreeable *compagnon de voyage* during my stay in Caledonia. We travelled north in one of those capacious and magnificent dining-saloons which must be alike the envy and admiration of those whose privilege it is to travel but seldom on either Midland or Great Northern Railway. It was absolutely springlike when we left the Midlands; but a very unwelcome weather change occurred almost immediately we crossed the border. Balmy air and bright sunshine gave place to howling wind and torrential rain; and the elements were "going it" with a vengeance when we finally left our train at St. Enoch's roomy station. Despite the bad weather, we were welcomed on the platform by Lieutenant Lee (one of the many teachers who served his queen and country in South Africa), the Conference secretary, and Mr. Robert Edgar, M.A., the "convener" of the Visitors' Committee. Throughout our stay, may I add, these gentlemen (along with many other sociable and hospitable Scots) did everything possible to make our visit both profitable and enjoyable. We were amongst the earliest arrivals at the fine Grand Hotel—the "headquarters" during Congress week—most of the visitors preferring to journey to Glasgow on the day the business began. But there were, nevertheless, sufficient bright and congenial spirits housed in the hotel to make even a Scottish "Sawbath" a less dreadful affair than we had anticipated. My comrade is generally known to be a *raconteur* of the first water, and in his presence a dull moment is hardly possible. Outside the hotel were snow and slush and sleet, intermingled, *mirabile dictu!* with a brief thunderstorm. Towards Sunday evening more Congressmen arrived, and the causerie in the smoke-room went on till a comparatively late hour.

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A Contrast.

ANOTHER hand will probably furnish the readers of THE PRACTICAL TEACHER with a full, true, and particular account of what transpired during the three days the Congress lasted. Nevertheless, the impression made on the mind of a visitor and guest may be worth recording. I journeyed north realizing, to the fullest extent, England's notorious inferiority to Scotland in the matter of national education. Had I not done so, my patriotic *amour propre* would, in all probability, have suffered so greatly as to make me feel uncomfortable. Rarely (if at all) was anything said during the sessions calculated to give us Englishmen a "good conceit" of ourselves, and possibly we returned home sufficiently humble. Yet I prefer infinitely the brisk, bright, and bustling character of our own Easter Conference to the solemn, prim, almost deadly-dull decorum of the Christmas Congress beyond the Tweed. It is difficult to conjecture what an English audience would do were four of its Conference sessions devoted to the reading of papers, followed by votes of thanks to the speakers, and motions proposed and seconded from the platform. Only *once* did I observe a "man on the floor" attempt to intervene with an observation or so; and the unwonted interference, no doubt, caused something like a mild shock. The papers, I must in fairness say, were of the highest possible literary and critical character—those of Mr. Thomas Shaw, K.C., M.P., Professor Edgar, Mr. Michael E. Sadler, and Mr. George Fenton especially so. How I longed to see an unofficial member of the Congress intervene in the forcible style to which we farther south are accustomed. The hour of "the young man" in the E.I.S. is apparently "not yet," but the sooner it comes the

better. The "side shows" were delightful and well-arranged, and I shall be ever grateful to the Scottish Class Teachers' Association, which was good enough to organise a pleasant little complimentary luncheon in my honour. The capacity of Scottish teachers for speeches on educational topics is apparently unbounded, and their good-nature equally, not to say more so. Otherwise one gentleman would hardly have dared to repeat the speech he made on the Monday to an audience composed of the same *personnel* on the Tuesday. All I can say is—I envy his courage!

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Nearing Buxton.

HARDLY is one Conference over before preparations are in hand for the next, and the next on the rota is the N.U.T. series of gatherings at Buxton. The general plan of 1902 is to be followed, the main variation being that the half-holiday on the Wednesday afternoon gives place to a private session. Personally, I regret this exceedingly, but the demand for adequate time in which to discuss the domestic affairs of the Union was too strong to be resisted at the January Executive meeting. As at Bristol, the public reception of Conference is timed for eleven o'clock on Easter Monday morning, and at this session it will be my privilege to formally instal my distinguished successor in the presidential chair. His address will practically occupy an entire session, and those who know Mr. Coward's work and worth will attend in large numbers, assured of hearing a first-class pronouncement on the education question. There will be plenty to discuss at the public sessions, no less than ninety-one motions on a variety of topics having been sent up by the affiliated branches of the N.U.T. Only forty-one motions have been forwarded for the private sessions; yet these will absorb many times the six hours allotted on Tuesday and Wednesday for their consideration. The financial statements have, for four or five years, been practically the sole subjects under review; and aspersions, insinuations, and innuendoes are not unknown when the Union's balance-sheet is to the fore. Some day the members of Conference will realise that *le jeu n'en vaut pas la chandelle*, and I would that the realisation should appear at Buxton. The excursions are likely to be more than usually attractive, as the following "probable list" proves: Chatsworth, Haddon, Castleton (visit to mines), Millers Dale; circular drive—Goyt Valley, Bakewell, and Lyne Hall. The prudent representative will book his rooms early, for though accommodation is plentiful at Buxton, the demand for it at Easter is very considerable.

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The B. and O. Council.

MY good friend Mr. William Bickerton, the assistant-secretary to the B. and O. Fund of the Union, was doubtless a proud man when he ascertained definitely that the income of the fund for 1902, from all sources, exceeded *twenty thousand pounds*. Nearly £4,000, it is true, were handed over to the charge of the council for a special purpose. Still the £15,000 which the council, twelve months ago, set itself to raise, has been more than secured; and on the Buxton Purse Day the jovial veteran, Mr. B. South, will have something to talk about. At the business meeting of the fund the council will recommend for adoption an alteration of rule, the effect of which (if carried) will be to compel every aspirant to membership of the council to become an *annual* subscriber. Seeing that *five shillings per year* is the modest qualification, I confess I have but little sympathy with those who talk largely of resisting this *on principle*. Mr. C. W. Hole, at the last council meeting, forcibly urged upon his fellow-members "the desirability of every person who wished to serve on the council making himself or herself an annual subscriber, if for nothing else than the sake of example." He carried his audience with him, too. Twenty members recorded their votes in favour of the alteration of rule, whilst only ten went into the opposite lobby. Significantly enough, the leader of the minority was that devoted worker for the charities, Mr. C. J. Chase, who is to-day the vice-chairman of the council.

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N.U.T. Elections.

DECEMBER 31st was the last day for sending in nominations for the Union elections. Only two gentlemen were nominated for the vice-presidency, and the loser this year is almost absolutely certain to succeed in 1904. All the sitting members are seeking re-election on the Executive; and the following table may not be uninteresting:—

District.	Nominees, in addition to the Present Sitting Members.
North England ...	Messrs. A. W. Dakers and C. Lynch.
Lancashire	Mr. F. R. Sparrow.
Yorkshire	Mr. F. W. Goldstone.
North Midland ...	Mr. H. Needham.
South Midland....	Miss Dix, Messrs. H. M. Cohen, A. Flavell, and W. Muscott.
East Anglia.....	Mr. J. Baldwin.
South England ...	Messrs. R. R. C. Gregory and F. J. Holdaway.
West England	Mr. E. Ruse.
Wales.....	Messrs. R. Nicholas and F. W. Pepperell.
North London.....	Messrs. J. B. Johnson and J. Kelly.
East London.....	Messrs. C. W. Crook and R. Wild.
South London.....	Messrs. T. T. Burkett and W. Folland.

Withdrawals are allowed up to January 31, and in all probability some of the candidates will not go to the poll. Every one will be delighted to find that Mr. Robert Wild, twice president of the Union, is still prepared to place his sound experience and ripe judgment at the disposal of his fellow-teachers. Doubtless, too, his constituents will need no reminding that the Lancashire *débâcle* of a year ago must, and can, be avoided. The Union cannot afford to lose its ex-presidents year by year. It is difficult to attempt a forecast of the Easter results. But it seems to me that Messrs. Dakers (in North England), Goldstone (in Yorkshire), and Ruse (in West England) are more likely than any others to "win a seat." I understand that an additional member will, under the Union's rules, be this year accorded to South Midland, East London, and South London. In all probability this will ensure the success of Messrs. Cohen, Wild, and Folland. *Nous verrons!*

A. C.

NOTES FROM THE NORTH.

The E.I.S. Congress.

THE twenty-ninth Congress of the E.I.S. was held on the 29th and 30th December in Glasgow, in the Bute Hall, kindly granted by the authorities of the University. As was to be expected in a centre so populous, there was a large gathering of teachers and the public, especially at the forenoon sederunts. It is a pity

that the acoustic properties of the Bute Hall are so very unsatisfactory, as many of the papers must have been almost inaudible to a great majority of those present. Despite this drawback, and the inclement state of the weather on the first day, the Congress deserves to rank as one of the best ever held under the auspices of the E.I.S. The papers were all on a high level, and if special attention was paid by the audience to that of Mr. Michael E. Sadler, it does not in any way reflect on the other speakers. Mr. Sadler's paper was of outstanding merit, and of such value to the profession that it will take its place as one of the finest papers delivered at any Congress.

THE President, Mr. A. T. Watson, Dumbarton Academy, dealt very largely with the subject of secondary education. He considered it the great question of the present day. No civilised country was at present satisfied with its solution of the problem. Our higher schools must continue and extend the direct development of head, heart, and hand aimed at in our lower schools. They must minister to the fundamental needs and real interests of the individual and of society. No hard and fast line could be drawn between culture and utility. Our higher schools must face the problem how best, with the increasing tendency to overburdened curricula, to advance the general adaptation of their pupils to the life outside of them. As the public gradually realised the benefit to be derived from a full secondary education, preparatory, especially, to entering university classes, they might hope to see their pupils more willing to complete the secondary courses designed for them up to the age of eighteen. Another reasonable demand of the times was that the national primary schools should be more effectively linked to the higher schools. He also referred to the recent speech of Lord Balfour, but gave no indication of his own opinion as to whether he would prefer the institution of magnified School Boards directly elected for the larger purpose above, or the placing of all education and educational funds under the management of county councils.

Secondary Education.

MR. THOMAS SHAW, M.P., dealt with this subject under three heads—namely, in theory, in experience, and in prospect. He emphasised the vital importance of preserving a directly-elected educational authority. With regard to the position of the teachers, he reckoned that the constant contact of the profession with the local representatives of the community, and the constant interest naturally taken by the body of the people of the district in the appointment and achievements of their teachers, had resulted in this, that Scotland to-day had, on a wider and more comprehensive scale, a sense of obligation towards and esteem for the teaching profession, a regard for its interest, and a desire for its honour such as no former generation of Scottish history could show. He was thankful, he said, that the abolition of School Boards, or the substitution for them of county councils or district councils, or an assault upon the *ad hoc* principle, which in Scotland had been so splendidly vindicated, was not in contemplation. The most powerful causes of the lack of progress in secondary education in their midst were—(1) the state of opinion among the working and humbler classes of the community; (2) the state of opinion among the middle and upper classes; and (3) confusion of finance and want of funds. As to the third point, Mr. Shaw said there was no difficulty about money. It was there for this purpose, and, on his reckoning, amounted to three times the sum required for buildings, maintenance, equipment, teaching staff, and apparatus, if Scotland would have the courage to stand together and demand it, the "equivalent grant" being a quarter of a million a year.

Modern Scottish Education in Relation to the State.

IT was clearly evident that the majority of the teachers present were not in agreement with Mr. Shaw's opinion, and were not so enamoured of the present School Board system. The policy of the Institute on the question was contained in a resolution proposed by Dr. Dickie—namely, "That, for the purposes of educational administration, the country should be divided into suitably large areas, each under one local authority having control of all kinds of education." The motion is purposely elastic and wide, but the principle is perfectly definite. With reference to tenure, Mr. Laurence, General Secretary, moved—"That in future legislation provision should be made to protect teachers from capricious dismissal." The two motions were unanimously agreed to, and thus Congress directly opposed Mr. Shaw's paper. It is a question whether it was fair either to Mr. Shaw or his opinions that he should have been asked to read this paper in view of the fact that these motions were to be proposed. The municipalisation of the profession is not desiderated because of the ambitions of the teachers, but because they think that thereby the education of the country would be materially advanced. It is idle to say that they desire to be Government servants, and to be emancipated from the School Board's close control. Lordly security, freedom from criticism, and the pensioned ease of the Civil Service are given as reasons for the desire of the teachers for larger areas. But these taunts are beside the mark.

Educational Administration and Tenure of Office.

MR. ALLEN CROFT, President of the N.U.T., conveyed the greetings of that body to the Congress. He made allusion to the English Education Act, and gave it as his opinion that it would be for the ultimate good of education. They had not got all they wanted—for instance, in regard to tenure—but, at any rate, they had got what they had not before, a modified sort of appeal to the local authority; and he did not think they would have the grotesque cases of dismissal they had had in the past. He was glad to hear that there was no religious difficulty in Scotland. There was none in England either. It existed only in the imaginations of politicians. It had never existed in the English schools. He trusted that when the Scottish Education Bill was passing through the House of Commons, the E.I.S. would have a member of Parliament to look after their interests. Mr. Harry Coward, Vice-President N.U.T., in supplementing, referred to the fact that though each country had a separate Code, yet both Codes were made in the same House of Commons, and that therefore it would be a good investment for the E.I.S. to have a teacher M.P. He expressed the pleasure it gave him to renew the many acquaintanceships he had made at Stirling Congress, and gave it as his opinion that the sending of delegates to the two conferences was of the utmost value to both associations. On

Foreign Delegates.

behalf of the I.N.T.O., Mr. Hegarty, Dublin, and Mr. Nealon, Nenagh, tendered their congratulations to the E.I.S., and conveyed their greetings to the Scottish teachers.

TO Professor Edgar, St. Andrews University, was entrusted the subject of modern languages. The belief in the educative value of modern languages he took to be at the basis of every demand for increased university recognition of French and German. He hoped their supporters did not desire to lower the standard of university work or ideals. French, like Latin or Greek, could be used by an able and cultivated teacher so as to improve English style; German, to develop the power of thought. Let teachers in their educational use of French and German demand from them what in their own degree they could really give—something of discipline for the intellect, something of inspiration for the mind. He asked if there would not be a great advantage in combining a modern and an ancient language, an easy and a more difficult one, to secure a great educational result. Could there be a better training for philosophy than a thorough study of Greek and German? Again, for advanced literary study and the perfection of style, could there be a better combination than Greek and French, artistically the most perfect languages in the world? A true humane education in the humanities must wed the old with the new, the present with the glorious past.

Modern Languages.

MR. MICHAEL E. SADLER, Director of Special Inquiries and Reports to the Board of Education, in the course of an able and forcible address, said that the great movement now going forward in American education was but one aspect of the national movement which was stirring American life to its depths. In that movement men of Scottish or Scottish-kin extraction were bearing a prominent part. Four things in American education especially deserved admiration. *Firstly*, progressive America heartily believed in education; rich and poor alike made sacrifices for it. The words carved on the public library at Boston were significant: "The Commonwealth requires the education of the people as the safeguard of order and liberty." By means of the schools the raw material furnished by immigration was ground up into an American democracy. *Secondly*, American educators spared no pains to stimulate the individuality of their pupils. American firms sometimes advertised for a "live man;" the American primary school was determined to produce a live child. The atmosphere of the American school and cottage was one of equality and independence. In education, as in business, an effort was made to encourage originality of suggestion. *Thirdly*, American teachers were experimenting in all directions with the object of leaving out the non-essentials in education. Applied science had changed the conditions of life in the world. Therefore, any education which sought to prepare the rising generation for modern life would have to reconsider its subject-matter, and, by omitting non-essentials, lessen the cost of production of active-minded, scientifically-equipped men of business and affairs. *Fourthly*, most of the great American men of business realised that schools and universities could help them by furnishing them with able assistants. They availed themselves of the services of well-trained college men, provided that the latter were free from academic conceit, and were willing to "begin with their feet in the dirt," in order to learn the practical side of business as thoroughly as they had grasped its theoretical side.

The Bright Side of American Education.

ON the other hand, Mr. Sadler drew attention to the darker parts of the picture of American education. In some cities municipal corruption had had baleful effects in the sphere of educational administration. Secondly, there was grave doubt whether the stricter kinds of intellectual discipline had not been unduly sacrificed in American schools to the desire of exciting and maintaining interest. In revolt from the repressive precision of the over-strict Puritan home, there had been a tendency to encourage among young children what was called "self-realisation," sometimes even to the point of impertinence. Another weakness was superficiality, accompanied by exaggeration in language and by love of excitement. A further danger lay in the influence of American over-zeal for business success over the minds of the rising generation, and thus indirectly on educational ideals.

The Darker Side of the Picture.

DR. MARION GILCHRIST, who, it may be observed, was the first lady medical graduate of Glasgow University, discussed the subject of defective eyesight in school children. Our educational system caused great injury to the eyes of children, and the general health suffered very materially from eye-strain, headaches, and other forms of nerve disease. The remedies for this state of matters she suggested were as follow:—The schools should be well lighted; adjustable desks ought to be provided, because children in the same class were not all of the same size; school-books should be printed in clear type on good paper; no child should be allowed to do any near work without a break of five or ten minutes in each hour—if not for active exercise, at least for rest to the eye; children should not be allowed to pore over books; and girls should not be asked, in addition to their bookwork, to do much fine needlework. It required some courage for a lady to propose this remedy, she thought, but she was convinced that needlework was a vice with some women.

The Eyesight of School Children.

THE subject of rural schools was ably dealt with in a paper by Mr. James Beattie, M.A., Oban High School. He thought the rural schools were entitled to a larger proportion of the imperial grants. The building, furnishing, and staffing of these schools required a greater outlay. As a result School Boards were employing provisionally certificated and unqualified teachers. The remedy he suggested was the abolition of the small School Board. Taking his own county, he pointed out that in Argyll there were 47 Boards, who had on an average the administration of three schools and 210 scholars; 23 of these Boards had fewer than 100 scholars to educate, 12 had fewer than 60, and one Board had 18 scholars. The result was that the most important occupation of some of these School Boards was to worry the teacher. With regard to attendance, he was strongly of opinion that the small School Board militated against regular attendance, and in not a few the members themselves were the

Rural Schools.

greatest culprits in the illegal employment of school children.

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Continuation Schools.

MR. G. FENTON, B.A., Vice-President E.I.S., had been asked to address Congress on this important subject. Unfortunately he was unable to be present, and in his absence Mr. Small, Glasgow, read the paper. At the outset he referred to the leading principles governing the Department in the construction of the Code—namely (1) The tuition given must have a direct bearing upon some industrial or commercial occupation; (2) the value of the specialised instruction would depend upon the thoroughness of the preliminary training; (3) the teachers must be experts in the subjects they taught. In dealing with the second of these points, he affirmed that at least twenty-five per cent. of those who left the day schools had not, and were not likely for some time to have, an education advanced enough to enable them to profit by the instruction given in the specialised classes of evening schools. With regard to immediate enrolment after leaving the day school, he calculated that of the 250,000 who ought to be attending evening schools, little more than a fifth of that number were to be found on the books, and less than a fifth in average attendance.

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Honouring the President of the N.U.T.

THE Scottish Class Teachers' Association, taking advantage of the fact that Mr. Allen Croft, President of the N.U.T., had been sent as a delegate to the Congress, resolved to entertain him to luncheon. The function was a decided success. The health of Mr. Croft was proposed by the President of the S.C.T.A. in a most felicitous speech. He referred to the great esteem in which Mr. Croft was held north of the Tweed, and eulogised the work he had done in England on behalf of the assistants. Mr. Croft, in reply, made a very happy speech. He took the opportunity of referring in scathing terms to the recent regulations of the Glasgow School Board in connection with C.P. He thought it was as yet but faintly realised by the general public that class teachers were men and women of lengthy experience, and in not a few cases of high academic distinction. They were the men and women who were in daily contact with the children, and were moulding the future citizens of our great empire. The highest ideals should be held by class teachers on account of the work they were engaged in.

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Other Adjuncts of Congress.

AS usual, there was a great round of gaieties in connection with the Congress. The annual dinner, with its reasoned flow of eloquence, was held on the Monday. On the same day many of those attending Congress had an opportunity of visiting one of the latest schools erected by the Glasgow School Board, and to see an excellent display of drawing, etc., arranged for by Mr. J. Vaughan, director of drawing. On the Tuesday the S.C.T.A. held their breakfast. The Solicitor-General for Scotland occupied the chair, and a most successful function it proved. The Glasgow Corporation held a conversazione in their magnificent municipal buildings. No fewer than 3,000 guests availed themselves of the invitation. Particular mention should be made of the excellent handbook of Congress, this year again presented by Messrs. Blackie and Son. Each year sees the handbook more artistic and more useful, and many no doubt who could not be present would be glad to have a copy as a souvenir of the Congress. The local officials, especially Mr. Wm. Lee, on whose shoulders fell the greater portion of the work, are to be congratulated on the results of their efforts to make Glasgow Congress of 1902 one of the best we have had, a task which all who were present will readily admit they accomplished.

R. G.

THE TEACHING OF WORKSHOP MATHEMATICS.*

BY FRANK CASTLE, M.I.M.E.,
Author of "Practical Physics."

I AM glad of the opportunity thus afforded to bring before your notice a few points in connection with what may be called elementary mathematical education, with special reference to engineering and business requirements.

It is a great temptation at the outset to contrast very briefly the state of affairs of, say, thirty or fifty years ago with that of the present day. In those days there is no doubt that comparatively large structures—such as bridges, roofs, etc.—would necessarily receive the attention of trained and qualified men; but lesser engineering problems were in too many cases left to the care of men nearly, if not altogether, illiterate, with the result that the design of an important engineering detail would be made to depend on some rule-of-thumb method, without any attempt to ascertain either the forces that had to be dealt with or the necessary amount of metal required for the purpose. If breakage occurred, it would perhaps be a comparatively easy matter to increase the size and, shall we add? the strength of the piece. It will be obvious that things could not continue for an indefinite period of time in such a slipshod or haphazard fashion. At the present time all the circumstances are changed; employer and employé alike find that foreign competition has to be reckoned with, and that allowances for possible mistakes due to ignorance in such matters as the strength and properties of materials cannot be made when preparing an estimate.

It follows that an engineer should have a good general training in elementary experimental science, more particularly in those sections dealing with physics and chemistry, and, in addition, should have as much useful mathematical knowledge and technical training as time and circumstances will permit. Of the subjects enumerated, probably mathematics receives least attention. My own experience as a teacher, extending over a period of twenty years, both with engineering and other students, convinces me that the main difficulty is invariably the mathematical one.

The general training suggested for engineers is obviously applicable to other professions. The next step would be to ascertain how this need is catered for by the various educational agencies. At the outset one must refer to the excellent work which has been and is still being done by the Science and Art Department (now forming part of the Board of Education), and to that of the Technical Education Board of the London County Council. The work of the latter in regard to technical education is too recent and too well known to need detailed description. By means of the former, classes in the various science subjects are to be found in nearly every town in England, Scotland, and Wales. The aim and scope of the recent addition to these subjects—practical mathematics—which we owe entirely to Professor Perry, must, I think, be familiar to all.

There seems to be very little doubt that the great public schools are falling rapidly behind their humbler educational competitors. As evidence of this we may mention that, of the first twelve wranglers in the last Cambridge Tripos, only five came from public schools, the remaining seven

* An Address delivered at the Conference of Teachers, L.C.C. Technical Education Board.

having gone up from grammar and Board schools; and, as you are aware, the Senior Wrangler held a London County Council intermediate scholarship. It seems to be admitted that the bulk of our public-school boys are more or less in a state of ignorance with regard to present-day requirements, and that every year they are carrying off fewer prizes at the universities, at the bar, in medicine, architecture, and in science. If we seek for an explanation of this anomalous state of affairs, we are too often told that it is impossible to give the average school-boy a taste for anything except sport; his memory, if taxed at all, spends itself on the herculean task of remembering the holder of any or every record since the Conquest. Those who are not foremost in such sports are content to watch the prowess of their fellow-students, and thus loaf away time which at least might be spent in a more profitable direction. Altogether, the only hopeful feature seems to be that their intense love of sport and manly games will tend to give the country a race which may be unsurpassed for courage and manliness; but is this enough? In these days, when the competition of nations, not merely in football and cricket, but in the intellectual and business world, has to be met, will it not be a sorrowful day when the cultivation and sharpening of intellect is sacrificed at the shrine of muscle and sport?

The question naturally occurs, Are we justified in assuming that the average boy has no taste for study? Assuming that it is so, is not the dislike largely due to a rigid, iron-bound educational system, which insists that before a boy can hope to take any pleasure in computation, he must be made to go through a long course in arithmetic, algebra, Euclid, and co-ordinate geometry? If he survives a stiff course in Euclid and co-ordinate geometry, there is some hope that he may eventually become a wretchedly-paid elementary teacher, quite able and well qualified to make others as wretched as himself. If, however, he wishes to be a successful business man, he must forget the system to which he has given so much attention and time, and must acquire more modern methods.

In fact, one would like to add that, to all appearances, the educational infant is at present in a bad state. In the event of a post-mortem, the verdict will probably be that the organs are perfectly healthy, and the collapse must be due to improper feeding, and the consequent inability to assimilate the food presented.

It may not be out of place to formulate a few conditions that an elementary course should satisfy, and ascertain how such conditions are met by existing methods. Thus, an arithmetical course, if properly taught, should serve not only as an instrument of mental training, but also for the valuable information which may be useful in after-life. Such a course should teach, among other things, neat methods of work, together with accuracy and rapidity in obtaining numerical results. This latter condition obviously implies that a student, instead of always depending on a given answer, should acquire the habit of checking his own results.

But in the usual course are these points attended to? I am afraid a negative answer must be given to such a query. A great deal of time is wasted in dealing with questions involving a large number of figures, when a smaller number would answer the purpose quite as well, or even better. One is, of course, quite aware that in dealing with questions such as finding the volume and weight of the earth and kindred problems, large numbers must be used, unless the unit is exceptionally large; but no such excuse can be offered when dealing with comparatively small numbers involving decimals, in which contracted methods should always find a place. This applies more particularly when dealing with data in which errors of observation or measurement may occur. With reference to these contracted methods, it would probably simplify matters if students were taught in multiplication to begin always with the left-hand, and therefore the most important, figure. If this course were followed more generally than it is with children, no difficulty would be found when dealing with contracted methods.

If we refer to the ordinary text-book on arithmetic, we find, instead of a few useful general methods, that it is stuffed full of so-called rules which are comparatively useless for any other purpose than that of obtaining answers to questions which they serve so well to illustrate. For instance, there cannot be much mental training in the antiquated method of proportion (simple and compound); this may and should be replaced by the unitary method, which not only shortens the labour involved, but also reduces some of the so-called higher rules to a few general principles. Assuming that, in addition to the first four rules, a boy is familiar with ratio and variation, he will soon invent labour-saving methods for himself.

In a brief address of this kind it is impossible to specify at any length the methods and rules referred to, or even to give typical examples; but work, clock and watch, velocity, races, etc., worked by tedious arithmetical processes, in which, when five given quantities are involved, as many separate rules must be given, should surely be treated as simple algebraical problems.

The following from a current text-book may be of some interest:—

Find the cost of 80 articles at 3s. 11¾d.

Here we are told to proceed as follows:—

80 × 3 = 240s. Then, 9d. being ¼ of 3s., we take ¼ of 240s., or 60s. 2d. being ⅓ of 1s., we take ⅓ of 80s.; and lastly, ¾d. being $\frac{1}{12}$ of 9d., we take $\frac{1}{12}$ of 60s. Adding all these together, we obtain the total cost, 318s. 4d.

Would any business man ever use such a roundabout method? Would it not at once suggest that the answer is simply 80 × 4s. less 80 farthings or 20d.

It would be an easy matter to cite many other instances, such as cube root, the decimalisation of money, the reduction of weights and measures, etc. Perhaps the following story, related by Mr. Barnes, the Mayor of St. Pancras, at a meeting of the London School Board on the 30th October last, may not be out of place. It appears that Mr. Barnes was recently at a bazaar at which two boys from one of the best schools under the Board had charge of a weighing-machine. The mayor was weighed, and received a paper upon which one of the boys wrote "14·0." On being asked the meaning, the boys answered 14 stones. As a little test they were asked to obtain the result in tons and hundredweights. The answer, carefully worked out, was given as one-eighth of a hundredweight. The boys were assured that the result was worthless, and the outcome of their second attempt was so surprising that it had to be carefully explained as follows: First, they had multiplied 14 by 14, obtaining as the product 196; this they divided by 4 (because there are 4 quarters in a hundredweight), giving 49. Finally, the 49 was divided by 20, so that according to the arithmetical methods of these boys the Mayor of St. Pancras weighs 2 tons 9 cwt.

It is not surprising that harmful results are so much in evidence, indicating mental nausea, paralysing effort, and destroying all interest in mathematics.

With regard to the order in which the various subjects should be presented, one would wish to break down the artificial barriers which do so much to retard educational progress. There seems to be no valid reason why mensuration and algebra should not, as far as possible, proceed simultaneously with arithmetic. The algebraical rules may be based upon arithmetical principles, and algebra thus becomes an extended and generalised arithmetic; in this manner, what would otherwise be the simplification of a meaningless algebraical expression becomes the solution of a definite and concrete arithmetical problem.

The use of four-figure logarithms might well be introduced much earlier than usual; in fact, there seems to be no reason why they should not form part of an arithmetical course, especially when dealing with problems in mensuration.

Simultaneously with the preceding, there should be a course in *graphical work*. Thus, provided with a fairly hard and well-sharpened pencil, a good scale, and a pair of compasses, the more important problems in Euclid should be carefully drawn to scale and their truth graphically verified. The same remarks will apply to trigonometry, in which, from the numerical lengths of the sides of a right-angled triangle, the trigonometrical ratios can be obtained. Again, in problems involving heights and distances, areas, scalar and vector quantities generally, the results may be obtained to a fair degree of accuracy by graphical methods.

Even in those cases where calculation is considered to be necessary, a carefully-drawn figure is of the utmost value, enabling numerical results to be readily checked.

It is impossible in the short time at disposal to do more than briefly refer to the many uses to which squared paper can be put in arithmetic, in experimental work, in algebra, in the applications of the simple functions, and the solutions of equations. It should always be recognised that order and regularity are more clearly and readily seen when exhibited to the eye in a picture than they are when presented in any other manner. In the process of plotting, far more is gained than the mere solution of a problem. By such means it is possible to give a clear idea of what is meant by "rates of increase," and thus convey accurate notions of differentiation. The same remarks apply to integration, which may be regarded as the reverse of differentiation, and its use in obtaining areas and volumes may be clearly seen.

From this point a clear notion of what constitutes a differential equation, together with the methods of obtaining the solutions of the more common recurring or practical cases, will not present much difficulty, especially if a teacher takes care at the outset to bring before the notice of the student some of the well-known laws or equations with which the student is probably familiar.

It will be seen from this brief sketch that no space is left for complicated and complex problems of slight educational value. These, in any form, require far more time than they are worth.

In conclusion, I may refer to the numerous strides forward which have marked things mathematical during even the last twelve months. The supersession of Euclid's *Elements*—for example, the Oxford and Cambridge Local Examinations no longer require the text of Euclid, nor is it required at the Little Go at Cambridge. The Civil Service Commissioners are setting modern papers in mathematics, and the London Matriculation has given its sanction to practical mathematics. Even in the matter of the training of naval officers changes in educational methods are necessary. Lord Selborne states that "the time has come to revise the methods of naval education. In the old days it sufficed if a naval officer were a seaman. Now he must be a seaman, a soldier, an engineer, and a man of science as well. More knowledge is needed than in the past, and the highest type of naval officer is that wherein great professional knowledge is added to force of character. The danger within the navy itself is lest insufficient importance should be attached to the results of study, and lest the value of what is called the practical character should be placed higher than it deserves."

The preceding may not at first sight appear to be a sufficiently rigorous mental discipline, but is it not better to get the practical notions first and theorise afterwards? Professor Perry says that "a person learns to use the calculus as he learns to use the chisel or the file on actual concrete bits of work." Even a child learns the use of his limbs without being taught the general conditions of equilibrium, or even the idea of centre of gravity, and no one has suggested that a child should learn to speak by first using a text-book on grammar.

COMENIUS AS AN EDUCATOR.

BY JAMES S. LAWSON, M.A.

THE teacher whose interest in his work is not confined altogether to the schoolroom, and who wishes to follow a practical scheme of education, cannot do better than study the works of Comenius, and specially the *Great Didactic*, which has now been translated into English by more than one eminent authority on the subject. In many details Comenius had been anticipated by Ratich and others; but no one had ever before suggested that from the very hour of its birth the education of a child should be catered for. A few of the more enterprising School Boards in our larger cities have been bold enough to provide what are called "Baby or Nursery Departments," under the charge of a specially-trained teacher; and to some extent the modern kindergarten system, which is based upon the principles of Pestalozzi and Froebel, does in its main features correspond to what Comenius called the "mother school," in which every child had to spend the first six years of its life. Education, in short, must begin on the mother's knee. However good the schools for elder pupils may be made, they cannot be really effective unless children come to them equipped with a thorough elementary grounding, as given by the patient mother.

Comenius divided the period of educational activity into four grades—infancy, childhood, boyhood, and youth. The education of each grade was to be pursued as follows:—(*a*) During infancy, on the mother's knees; (*b*) during childhood, in the vernacular school; (*c*) during boyhood, in the Latin school or gymnasium; and (*d*) during youth, in the university and by travel. A "mother school" should exist in every house (where there are children), a vernacular school in every village or hamlet, one gymnasium or more, according to size, in every town, and a university in every kingdom or province. Whilst the same subjects are to be taught throughout the child's school career, this is to be done in a different way, according to the state of development of the mental faculties. In the "mother school" the organs of sense only are to be exercised, and everything taught in a general way, so that the objects of external nature may be distinguished. Later on, imagination, memory, and will begin to make their power felt, and their exercise must not be neglected. Imagination first, then intellect, then will are to be cultivated.

Comenius compared the four classes of schools to the four seasons of the year. The "mother school" reminds us of gentle spring, with flowers of varied hue and scent. Summer, with full ears and ripening fruit, represents the vernacular school. The gymnasium corresponds to autumn, the time of harvest and fruit-storing. Last of all, winter is the university, for here we prepare for various uses the fruit already collected, in order that it may sustain us for the rest of life. The methods to be adopted in each school are compared to the growth of a tree. Children up to six years of age are like shoots, which, carefully planted, have taken root, and are beginning to put forth buds. At twelve they are like a young tree, covered with branches and leaves; in the next period they resemble trees covered with blossoms, giving promise of fruit; and lastly, when fresh from the university, they may be compared to trees covered with fruit ready to be plucked for use whenever required.

It is exceedingly doubtful whether it is possible, under modern conditions, to carry out in its entirety the principle of the "mother school," when the demands upon a mother's

time are so multifarious. In the case of the very poor, such a scheme is well-nigh impracticable, the mother having little or no assistance in her everyday household duties; but where a nursery-governess or mother's help is kept, a good deal may be done on the right lines. In case, then, there should be any who took sufficient interest in the education of their children, and had the time to devote to their instruction, Comenius prepared a handbook containing information for the advice and guidance of parents, and setting forth the subjects to be taught. This work was similar in character to John Locke's edition of *Æsop's Fables*, published to illustrate his system of interlinear translation. The illustrations —which included the Tortoise, Crab, Camel, Bear, Tiger, Leopard, Fishes, Beetle, Owl, Dolphin, Spider, Hawk, Cuckoo, Calf, and Swan—were such as could be utilised by a resourceful teacher to form the groundwork of elementary lessons in natural history. The drawings, though rough, were such as young children might be expected to copy with a fair degree of accuracy.

Another useful aid to study was the picture-book, the *Orbis Pictus*, or "World in Pictures," used both in the mother and vernacular schools. At this stage the child's education is to be carried on by means of sense perception. Sight being the most important of the senses, pictures of objects, such as mountains, valleys, rivers, trees, birds, fishes, horses, and sheep, as well as the sun, moon, stars, and clouds, are to be placed before his eyes. The knowledge of things is to be combined, in as graphic a manner as possible, with that of words, by treating in the lessons of subjects readily intelligible to the pupils, such as animals, trades, sports, and so on. Wherever possible, the pupil is to be asked to make a rough drawing of the object in question. Then articles of household and workshop use, such as a cup and saucer, spoon, knife, fork, plate, kettle, pot, nail, hammer, and pincers, are to be added. Pictures such as those of a king and queen with crown and sceptre, a soldier with armour, a husbandman with his plough, and a wagoner with his wagon and post-cart, are of great educational value in the vernacular or national school of the mother tongue. Over each picture is written clearly the name of the object it represents. In this way objects are assisted to make an impression upon the mind, the little ones get accustomed to the idea that pleasure is to be derived from books, and they are, at the same time, taught to read intelligently. The powers of observation are thus enabled to develop more fully and accurately. It is satisfactory to note that the infant departments of many of the public elementary schools in this country are conducted very much after the model of Comenius; and it would undoubtedly be a decided advantage to higher education if the junior departments of our secondary and grammar schools were modelled more according to the same plan.

In the vernacular school the *Orbis Pictus* served as a kind of "object-lesson" book. Boys—and girls too—at all times delight in pictures, and feast their eyes greedily upon them. They will even occupy much of their time during school hours, as well as at home, in making drawings of objects around them. This should be encouraged rather than otherwise. Illustrated books of any kind excite a child's interest, and help to rivet the attention. The *Orbis Pictus* of Comenius, published among his complete works in 1657, was the first picture-book ever written for the young. It was immensely popular both amongst parents and children, and it was bought by thousands. Each section had a picture corresponding to it, and numbers opposite the words to enable the pupil to pick out the exact object numbered in the picture. It also served as a reading-book, the letters and names of pronunciation being learned from a kind of picture alphabet which suggested a connection between the sound of the letter and the cry of the animal whose picture is shown.

The arrangement adopted in the *Orbis Pictus* of Comenius is the kind best suited for the teaching of languages in the grammar school of to-day, and to a great extent resembles the "natural method" of learning a foreign language. It has been proved by actual experience to be the most successful method of teaching French and German. If applied to Latin and Greek, the subject would become very much more interesting to both teacher and taught, and would produce more useful and lasting results. A brief description will suffice to explain the language-system of Comenius. On a card is exhibited a picture, underneath which will be found in parallel columns the English and Latin words for the different parts of a house (*domus*), such as the door (*janua*), threshold (*limen*), lintel (*superliminare*), posts (*postes*), hinges (*cardines*), latch (*claustrum*), windows (*fenestræ*), roof (*tectum*), and stairs (*scalæ*). Similarly with a ship (*navis*), the various parts of which are indicated by numbers—namely, the oars (*remi*), rowers (*remiges*), shipmaster (*proreta*), forecastle (*prora*), steersman (*gubernator*), stern (*puppis*), and the rudder (*clavus*). According to this method, boys should be exercised in making rough sketches of a ship, a building, or an animal, and at the same time write down the names, in the language they are learning, of the different parts of an object. The pronunciation of the names when written will form an excellent oral lesson. The pupils should also be encouraged, as far as possible, to express their ideas on different objects in grammatical sentences, paying strict attention to the idiom of the language they are studying.

The *Janua Linguarum*, one of the most important of Comenius's works, was intended to facilitate the power of speaking and writing Latin by weaving numerous Latin words into paragraphs in which they might be easily learned. This book made the tour of Europe, and was translated into no fewer than twelve languages. His greatest work, however, was the *Didactica Magna*, a complete handbook of education in all its branches, and the first attempt to write a systematic treatise on the whole subject. An extract from the preface to this work made its way to this country, and as a result Comenius was invited to England by Parliament to aid in organising public instruction. Being afterwards summoned to Hungary, he devoted himself to remodelling the school system of that country. He devised a system of school work, dividing the school into seven classes, each class to occupy a year, from the age of ten to that of seventeen. The first three classes, which would correspond with the junior department of a well-equipped grammar school of to-day, were to acquire a knowledge of common objects, writing, arithmetic, Latin, geometry, music, and gymnastic games, while the remaining four classes were to be taught mental philosophy, logic, and citizenship or political economy. The crown of the whole system is the university, in which all the sciences are to be taught, and the future teachers and leaders of the community are to be trained.

Born in Moravia towards the end of the sixteenth century, John Amos Comenius, or Komenski, may be considered one of the earliest and most vigorous educational reformers of modern Europe. It was he who first recognised the stimulus which had been given to educational reform by the dawn of that illumination of intellect which in the history of the mind is usually associated with the name of Francis Bacon. The method of induction had begun to be substituted for that of deduction in every kind of research, and it was only natural that a great impulse should be imparted to the science of education. In his opinion the most reasonable course was to follow the guidance of nature, and, by learning her secrets through careful inquiry and experience, to interpret natural laws. The man who felt himself called upon to reorganise education on this new basis, and to train a new generation of the human race for more difficult enterprise and greater conquests, was John Amos Comenius. In this country much has been done in the elementary school and the university to put into actual practice Comenius's notions of education, but the gap between these institutions still remains very wide. A thoroughly organised scheme of secondary education, such as already exists in Germany, Scotland, and Wales, if carried out effectively in England, would do much to revive the principles of Comenius in our public grammar schools. Once again we have come to the parting of the ways, and a new era of educational effort is slowly but surely dawning. It is the earnest hope of every teacher that the Education Act of 1902 will stand out conspicuously as a landmark in the history of our scholastic system, and that one result, at least, of the placing of this much-debated and complicated measure upon the statute-book will be to sweep away for ever the chaos and confusion which for so many years have been a blot upon English schools and education.

A BELATED EDUCATIONAL REFORMER.

THERE have been many ideal Republics described ere now, and that foreshadowed by Mr. H. G. Wells in his series of articles in the *Fortnightly* has the advantage of being the last. It has the further advantage of being the only one whose creator has attempted to point the way by which it may be reached by men; though it must be added that he would perhaps add to this benefit if he would also point the "way out" for the sake of those, and they are many, who do not regard the New Republic as a very desirable place to live in. To readers of this journal, Mr. Wells's contribution to the January number will be of some interest, as he deals in it with the education of the citizens of the new State. We turned to it eagerly in the expectation that we should find something far in advance of the ordinary ideas of our time, or at least a suggestive interpretation of the tendencies which the initiated may trace in our present stage of thought. In either respect the article is most unsatisfactory. Most of the reforms which are gravely and even portentously brought forward have been commonplaces of school practice for ten or twenty years, or have been tried and discarded for something better. This is not what we have a right to expect from Mr. Wells in dealing with education.

The making of the citizen, he rightly affirms, begins in the nursery; and at this stage he points out that the children of the rich are apt to be at a disadvantage. As he says in a sentence whose meaning is clear, although its structure is somewhat abnormal: "The poor little soul wails as often for events as the slum baby does for nourishment. Into its gray nursery there rushes every day, or every other day, a breathless, preoccupied, excessively-dressed, cleverish, many-sided, fundamentally silly, and universally incapable woman, vociferates a little conventional affection, slaps a kiss or so upon her offspring, and goes off again to collect that daily meed of admiration and cheap envy which is the gusto of her world."

It may be noted that here and throughout Mr. Wells uses the pronoun "it" in speaking of the child (if we may dare to use the term *pronoun* after reading his savage condemnation of grammar), and probably, in the view of our lady readers, this "it" will be enough to discount all he says about babies.

Our writer is strong on the need for "interest" in the early surroundings of the child, but we should know better whether we agree with him or not if he had indicated what he means by the word. The subject of interest in children has been much studied of late, and we have still a good deal to learn about interest at the nursery stage; but Mr. Wells goes serenely on to dogmatise on the basis of this unknown quantity regarding the proper surroundings of the baby, and declares that, "To go along a road with some traffic is better for a child than to go along a secluded path between hedges; a street corner is better than a laurel plantation as a pitch for perambulators." With the same assumed knowledge he offers the opinion that "it would be possible to devise a much more entertaining set of toys for an infant than is at present procurable; but, unhappily, they would not appeal to the intelligence of the average parent. There would be, for example, one or two little boxes of different shapes and substances with lids to take off and on, one or two rubber things that would bend and twist about and admit of chewing, a ball and a box made of china, a fluffy flexible thing like a rabbit's tail with the vertebræ replaced by cane, a velvet-covered ball, a powder-puff, and so on." Any reader who has discovered the principle on which this list is founded will be able to interpret the "so on" with which it closes.

Much stress is laid on the proper pronunciation of the mother tongue in the nursery, and "baby-talk" is condemned, as is also the employment of a French or German nurse to give early practice in the pronunciation of foreign tongues. This is held to be a useless expedient, on the quite inadequate ground that "hardly one of us can remember" things that happen at so early an age, which, if it were at all pertinent to the question, would tell equally against the need for care in the pronunciation of English at that age.

Regarding the study of children, Mr. Wells is sound in theory, and he looks to it for much improvement in early education. In practice, it is to be feared, his attitude is less reasonable. There is nothing in his paper to indicate that he has based his own recommendations on an adequate study of children, and his expressed contempt for those who are engaged in this study is hardly warranted by anything that they have done, or that he has done. He would have the "quite ineffectual talking societies" replaced by a "committee with adequate funds," organised by "a few men of means and capacity," which should, "with the assistance of a good writer or so," issue a complete guide to the nursery, including the striking novelty of nursery rhymes. We are evidently on the eve of revolutionary developments in early education!

Perhaps the most serious part of the article is a long digression on the teaching of English. The importance attached by the writer to the acquisition of a copious vocabulary gives quite a mediæval flavour to this part of the paper. The universal ignorance of English is much insisted on, and rightly deplored, though the course of the argument is at times rather odd. For example, Mr. Wells regards the origin of a slang word as due to ignorance of the proper word to express the idea which the "slangist" has in his mind (we coin the term to illustrate the process). This seems a new discovery in philology. But a few paragraphs farther on we are told that to be ignorant of a word means that we have no means of comprehending the idea which it represents, and this is, of course, incompatible with the statement regarding the coining of a slang equivalent. Of two incompatible statements one is always wrong; in this case both are.

Since ignorance of English—that is, as his paper seems to imply, ignorance of its full vocabulary of some 120,000 words—means an undeveloped intelligence—"a gap in a man's vocabulary is a hole and tatter in his mind"—the need for more teaching of words is evident, and the limited vocabulary of the most of us is a matter of grave concern. Yet we do not realise our defect; that is the most hopeless thing about our present state. Even our most scholarly men do not; "except among a few writers and critics, there is little sense of defect in this matter." One result of our want of vocabulary is that a "writer who aims to be widely read" must mar his natural style, must omit "simple and necessary words," and must write down to the capacity or the incapacity of those who read. Now, as Mr. Wells doubtless "aims to be widely read," we must allow him to be an expert witness in this case; but our own feeling regarding his writing is that he would be much more intelligible and no less widely read if he had written really good English, and had avoided many of the solecisms which mar his style, but which, after reading this statement of his method, we must suppose to be due to an attempt to render himself intelligible to the masses. "Only thoughts that can be expressed in the meanest commonplaces will ever reach the minds of the majority of the English-speaking peoples under present conditions," he declares; and yet we cannot forget that there is such a book as the English Bible, which is "widely read" to-day, and is more intelligible to the masses than the works of even the "few writers and critics."

For our inability to understand all but "the meanest commonplaces," our readers will not be surprised to learn that they themselves—the teachers of the present day—are, in Mr. Wells's opinion, chiefly to blame. "Schoolmasters, as a class, know little of the language;" "they are too ill-educated to teach it properly." Not only are they ignorant of English, but they are dishonest as well, for they teach "a certain preposterous nonsense called English grammar,"—"because they are utterly ignorant, and know themselves to be utterly ignorant of the reality of the subject, and because, therefore, they have to humbug the parent and pass the time by unreal inventions." Grammar in school work, like philosophy or poetry in a higher sphere, is always an easy mark for the cheap sneers of those who are unable to appreciate its real function in education; but this is the first time, so far as we know, that the teaching of grammar has been attributed to anything worse than mere ignorance. We wish to give our writer full credit for all that is really original in his paper.

While on this subject of grammar, we may quote a sentence from a paper just published by a well-known educationist, Mr. W. T. Harris of the Bureau of Education, Washington: "This study develops the power of introspection more than any other subject. It enables one to analyse readily and accurately a complex statement or a complex nexus of conditions presented to him, and gives him a growing power to separate the essential from the unessential, and to discriminate things and forces, and reach clearness through a connected process." If this be so, the utility of grammatical study may easily be unappreciated by minds of a certain type.

Our readers will understand why we quote the following suggested "reform," and italicise the second sentence: "It would not be unreasonable to require from all those who are qualifying for the work of education the reading aloud of long passages in the standard accent. *At present there is no require-*

ment of this sort in England." Mr. Wells in this conection refers to the pulpit as being able to help; but many who have heard the reading in both the church and the school will be inclined to suggest that the former has, as a rule, more need to learn from the latter.

The reading of this paper has reminded us of Mr. Wells's two attempts to forecast the future of our cities. In his first essay he gave us a picture of a city developed vertically upwards within narrow limits, with many improvements, no doubt, but still only an intensified London. In his later prophecy he gives a totally different forecast, that of a city spread over a wide district, which is clearly more in accordance with the trend of modern tendencies. What was the cause of his error, and the key to its rectification? In the first instance, as he himself pointed out, he omitted to take account of the development of the means of locomotion. This is symbolical of his failure to make a forecast of education which would be of real value; his conceptions are statical rather than dynamical throughout, even when he tries to forecast movement. The "motor car" element has to be dealt with in this sphere as well as in the material sphere with which his other prophecy was concerned; and an attempt to predict the future, or even to suggest reforms which will have any real value in the present, by a writer equipped with only obsolete or superficial ideas on the subject with which he is dealing, can only result in a production such as Mr. Wells has unfortunately given us in his paper. The pity of it is that the readers of the *Fortnightly* may be much more ready to accord to the writer the position of an expert in education than the readers of this journal are likely to be.

WELL-KNOWN TEACHERS AT WORK.

MR. JAMES WATSON,

LEYLANDS BOARD SCHOOL, LEEDS.

THIS school is justly renowned for its particularly fine attendance, and we felt that an interview with the head-teacher would be of material use to our readers. We called on Mr. Watson at school, and told him so. "Oh yes," said he, "we won that £60 piano from a firm of publishers because we had the best attendance in the country from the beginning of May 1900 to the end of April 1901."—"What was your return?"—"We had 680 in average attendance, and the percentage for the year to the average number on roll was 99·4. We also won in this school the prize for the best individual class. Miss Warham's class there took it with a percentage of 99·9."

All this was very interesting and wonderful, so we asked Mr. Watson to favour us with a few hints for the benefit of our readers.

"The first thing I should say is that what is possible here is perhaps not possible in many places. You will observe that 99·5 per cent. of the children are Jews, and Jewish children do not seem to be troubled with the same juvenile diseases as do the ordinary English children. The Jew parent is very keen to have his children educated. For the rest, it may be summed up in one word—*enthusiasm*. The children, the teachers, and the parents are all proud of the pre-eminent position the school has attained, and this is now the most important factor in helping us."

"How many have you away this morning?"

"Only four out of 700."

"Does any prize scheme help you at all?"

"Oh yes. The Board's scheme gives a special prize to 'perfect' attenders, and an ordinary prize to boys who make 97 per cent. of punctual attendances, and to girls who make 95 per cent. For the school year ended midsummer 1902 we had 278 special prizes and 239 ordinary prizes, a total of 517 out of 571 who had been on roll the whole of the year."

"That is extraordinary. How is it done?"

"Well, come into this classroom. Here you see on the wall a card containing the names of all the children in the class. When one is late or absent a '*l*' or '*O*' is entered on that card. These are kept throughout the year in front of the children, so that they can see their record to date. I have known a child be within one mark of missing his prize at the end of three months of the school year and not miss his prize after all. They all know exactly at any time how they stand. Twenty black marks or absences will lose a prize. Hence the anxiety not to get twenty on that card.

"The relative weekly positions of each class are prominently displayed in the school, and the list is read out to the assembled children once a week.

"An absentee form is invariably sent after an absentee by the teacher, and the attendance-officer receives a list once a week of bad cases only, if necessary. Then I distribute to parents annually a printed copy of the attendance record. Here is this year's:—

BOARD'S MONTHLY RETURNS.

Month.	1898.	1899.	1900.	1901.	1902.
JAN.	98	98	99	99	100
FEB.	99	99	98	99	99
MARCH.	99	99	98	100	99
APRIL.	99	99	98	100	99
MAY.	99	100	100	99	99
JUNE.	99	99	100	99	99
JULY.	99	99	100	99	99
AUG.	98	99	100	99	99
SEPT.	98	99	100	99	99
OCT.	98	99	99	99	99
NOV.	98	99	99	99	99
DEC.	98	99	100	99	99

Average attendance for 1902 is 680.

"Children who are neither absent nor late during the year receive special prizes; and boys who are punctual and regular 97 per cent., and girls who are punctual and regular 95 per cent. of the times the school is open, receive ordinary prizes.

RECORD PRIZE YEAR, 1902.

STANDARD.		Total Prizes Possible.	Number of Special Prizes Won.	Number of Ordinary Prizes Won.	Total Prizes Won.
VI.		22	13	8	21
V.		46	29	14	43
IV.	**a**	**45**	**31**	**14**	**45**
	b	33	17	14	31
III.	a	48	33	14	47
	b	50	22	25	47
II.	a	36	15	20	35
	b	48	21	24	45
	c	45	22	18	40
I.	a	41	12	21	33
	b	45	22	19	41
	c	39	12	14	26
	d	38	19	13	32
P		35	10	21	31

278 special prizes.
239 ordinary prizes.
Total.....517 prizes out of a possible 571.

"One more thing. The enthusiasm is constant, not spasmodic, and that is the whole secret."

"With such attendance, Mr. Watson, teaching must be comparatively easy."

"Well, yes, after they learn to speak the English language. Come this way. Here is our preparatory class (about forty children). They are recent immigrants, mostly from Russia,

and not one of those children could speak a word of English when they came here."

"How do they compare with English children in capacity and intelligence?"

"My experience is that, as a rule, they are more intelligent than English children. Another fine characteristic is that they are very easily 'enthused,' and it is then possible to get them to rise to almost any occasion. We have been able to make these children come to school as clean and tidy as any children in the city."

"I wish I had been giving evidence before that Commission which is sitting in London," said Mr. Watson, in answer to another question. "I consider the morals infinitely better here in this Hebrew colony than those in the contiguous districts. I have been here five years, and have never seen a drunken Jew yet."

"And now, Mr. Watson, with regard to the general working of your school. What staff have you?"

"Oh, a very good one. I have eleven certificated assistants (seven women and four men), two ex-pupil teachers, and one Art. 68."

"Any pupil teachers?"

"Oh yes, five; but we do not reckon them on the staff. They are away at the Centre half their time, and we look on

MR. JAMES WATSON.

them here as articled pupils, learning their business under proper supervision. All my men teachers are trained, and four of the women also have had that advantage."

"You are a Battersea man, I think, Mr. Watson."

"Yes; 1888–9."

"A big school like this must be difficult to organise."

"Yes, till you master it. Discipline is the first essential, of course; and there must be method, to save worry and time. Every child here sits in the same place the year through. It has many advantages. I know which children are absent when I look at the class. Materials are also given out in practically no time, as the books, etc., pass out to the same place."

Just at this moment came play-time, and Mr. Watson proceeded to dismiss the school. The bell rang, a teacher sat at the piano, and then the master said, "Those who dare not hear music stand forward."

"Perhaps you don't understand that," said he.

"No, indeed. What does it mean?"

"It means that they have had a death in the family during the past fortnight, and I have always a few who must not hear the piano."

Then the children went out. It took just two minutes to dismiss 700, and was done with a precision that would have done credit to a regiment of the line.

During the play-time we turned up the visitors' book, and found, among others, that the school had been visited by

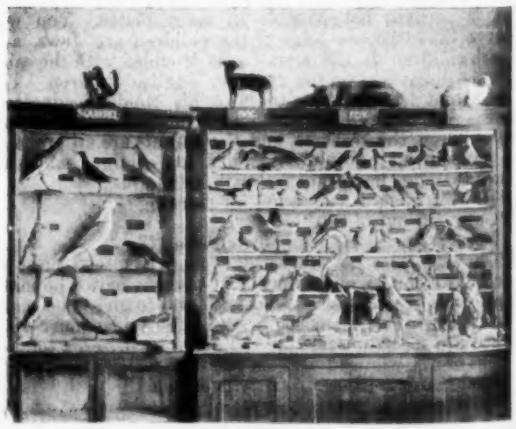
LEYLANDS BOARD SCHOOL, LEEDS.

Dr. Eicholz, H.M. Inspector, who entered, "Delighted with everything;" Mr. P. A. Barnett, H.M. Inspector, who said, "This school is a monument of excellent work;" Mr. F. King, H.M. Senior Chief Inspector; Mr. J. and Mrs. Jamieson of Melbourne University; H. Lunde, "Kristiania," as he spelt it, and many other foreigners; Mr. W. P. Turnbull, H.M. Inspector for the North-East District; Mr. R. E. Hughes, H.M. Inspector for the Swansea District, all of whom made commendatory entries. The local H.M. Inspectors are, of course, often there, and their reports speak for themselves. Here is the last one:—

"This school has become justly renowned throughout the country for its marvellously regular attendance. The general management of the school, the tact with which peculiar difficulties are met, and the intelligence of the teaching are all worthy of special commendation."

They are all alike, and the intelligence is a feature ever kept before the teacher. The museums are perhaps the best stocked it has ever been our lot to see. We have pleasure in giving a photograph of one of them. Mr. Watson is proud of them. They represent hours, nay weeks, of patient collection and begging on his part; and now he prides himself that no object lesson need be given without either the object or a model of it being placed before the class. Photographs of these museums were sent to the Nature-Study Exhibition held in London early this year.

"We watch the reading," observed Mr. Watson, in answer



MUSEUM.

to a further question, "both in and out of school. The children in the upper classes subscribe a halfpenny a fortnight

TIME-TABLE—LEYLANDS SCHOOL (MIXED DEPARTMENT).

	MORNING.							AFTERNOON.					
	9 to 9.30.	Standard.	9.30 to 10.15.	10.15 to 11.	11 to 11.15.	11.15 to 11.45.	11.45 to 12.	1.30 to 2.15.	2.15 to 2.45.	2.45 to 2.55.	2.55 to 3.30.	3.30 to 4.
MONDAY.	RELIGIOUS INSTRUCTION.	VI.	Arithmetic.	Reading.	RECREATION.	Boys.—Spelling.	Girls.—Needlework.	Geography.	Drawing.	RECREATION.	Grammar.	Mapping.
		V.	Drawing.	,,		,,	,,	Grammar.	Composition.		Arithmetic.	Transcription.
		IV.	Geography.	Recitation.		Reading.	,,	Reading.	Singing.		Drawing.	Arithmetic.
		III.	Recitation.	Elem. Science.		,,	,,	,,	Tables.		,,	Dictation.
		II.	Arithmetic.	Copy Books.		,,	,,	Drawing.	Composition.		Recitation.	Singing.
		I. a, b, P.	,,	,,		,,	,,	,,	,,		Reading.	,,
		I. c, d.	Elem. Science.	Recitation.		,,	,,	Reading.	Spelling.		Copy Books.	Arithmetic.
TUESDAY.		VI.	Arithmetic.	Composition.		Reading.	Singing.	Manual Instruction and Arithmetic.	Spelling.		Cookery. Reading.	Drawing.
		V.	,,	Manual Inst. Spelling.		& Cookery. Reading.	Reading.	Geography.	Copy Books.		Mapping.	Arithmetic.
		IV.	,,	Cookery. Dictation.		Cookery. Reading.	Spelling.	Elemen. Science.	Cookery Reading.		Cookery. Drawing.	,,
		III.	,,	,,		,,	,,	Geography.	Singing.		Copy Books.	,,
		II.	Reading.	Elem. Science.		Hand and Eye Training.		Arithmetic.	Drawing.		Reading.	Spelling.
		I. a, b, P.	,,	,,		,,	,,	,,	,,		,,	,,
		I. c, d.	Arithmetic.	Drawing.		Reading.	Spelling.	Geography.	Singing.		Transcrip.	Arithmetic.
WEDNESDAY.		VI.	Arithmetic.	Physiology.		Drawing.		History.	Drill.		Drawing.	Reading.
		V.	,,	Recitation.		Reading.		Drawing.	Singing.		Composition.	Drill.
		IV.	,,	Dictation.		History.		,,	Drill.		Reading.	Tables.
		III.	,,	,,		Reading. | Spelling.		,,	,,		Arithmetic.	Reading.
		II	Reading.	Tables.		Dictation.		Geography.	Arithmetic.		Drill.	Transcription.
		I. a, b, P.	,,	Geography.		Arithmetic.		Recitation.	Tables.		,,	,,
		I. c, d.	Arithmetic.	Copy Books.		Reading. | Spelling.		Transcription.	Drill.		Reading.	Tables.
THURSDAY.		VI.	Reading.	Composition.		Recitation.		Geography.	Copy Books.		Grammar.	Arithmetic.
		V.	Arithmetic.	History.		Physiology.		,,	Reading.		Composition.	,,
		IV.	Geography.	Reading.		Copy Books.		Grammar.	Spelling.		Drawing.	,,
		III.	Reading.	Elem. Science.		Composition.		Geography.	Arithmetic.		Hand and Eye Training.	
		II.	Drawing.	Dictation.		Geography.		Arithmetic.	Copy Books.		Reading.	Spelling.
		I. a, b, P.	,,	Transcription.		,,		,,	,,		,,	,,
		I. c, d.	Reading.	Geography.		Hand and Eye Training.		Elemen. Science.	Arithmetic.		Drawing.	Composition.
FRIDAY.		VI.	Arithmetic.	Composition.		Drawing.	Singing.	Boys. Girls. Mensuration. | Needlework.	Boys. Reading.		2.55 to 3.45. Songs.	3.45 to 4. Oral Compos.
		V.	,,	,,		Drawing.		Mensuration.	Reading.		,,	,,
		IV.	,,	,,		Reading. | Spelling.		Hand and Eye Train.	,,		,,	,,
		III.	,,	Drawing.		,,	,,	Reading.	Spelling.		,,	,,
		II.	Reading.	Elem. Science.		Arithmetic.		,,	,,		,,	,,
		I. a, b, P.	,,	,,		,,	,,	,,	,,		,,	,,
		I. c, d.	Arithmetic.	Drawing.		Reading. | Spelling.		,,	,,		,,	,,

each for illustrated papers, and we make use of the neighbouring public library. The children report what books they have read, and we give them composition on some character in them. Of course, we give them advice as to what to read. Here is a list of them on the wall. Then we have here an 'Observation Chart,' on which children enter things themselves which they have observed in their life outside school. In the hands of a good teacher that is very valuable."

"And what about religious instruction here, Mr. Watson?"

"No difficulty even here. It is understood that the Jews take advantage of the conscience clause so far as the New Testament is concerned; but they gladly take the Old Testament from us, Christians though most of us are. A proper syllabus is used, almost the same, with the excision of the New Testament, as is used in every other Leeds Board School. The rest is done out of school hours in this building and elsewhere by the Hebrew community themselves at their own expense, except that the School Board lends them the room free of charge. No difficulty whatever, I assure you. The Jews are thankful that we do so much."

One thing which is perhaps characteristic of the race is that thrift seems to have a great hold on these children. "The *second* best school bank in Yorkshire, I believe," said the master. "Last year we had 25,130 deposits, and £615, 8s. 4d. deposited."

It remains only to be said that this school is in what is known in Leeds as the "insanitary area," and yet has the best attendance, which speaks volumes for the effect on the health of mankind of a close observation of the Mosaic law, which is perhaps the best code of sanitation yet extant.

We left Mr. Watson, delighted with all we had seen, fervently wishing that English children were as keen to take advantage of the opportunities offered them as are these foreign children, who come and take with keenness what is given them, eventually beating our own people on their own ground, and through what we have done for them.

ABSENTEE FORM.

LEEDS SCHOOL BOARD.

....*Board School,*

.....*190*

DEAR SIR (OR MADAM),

I have to remind you that.....

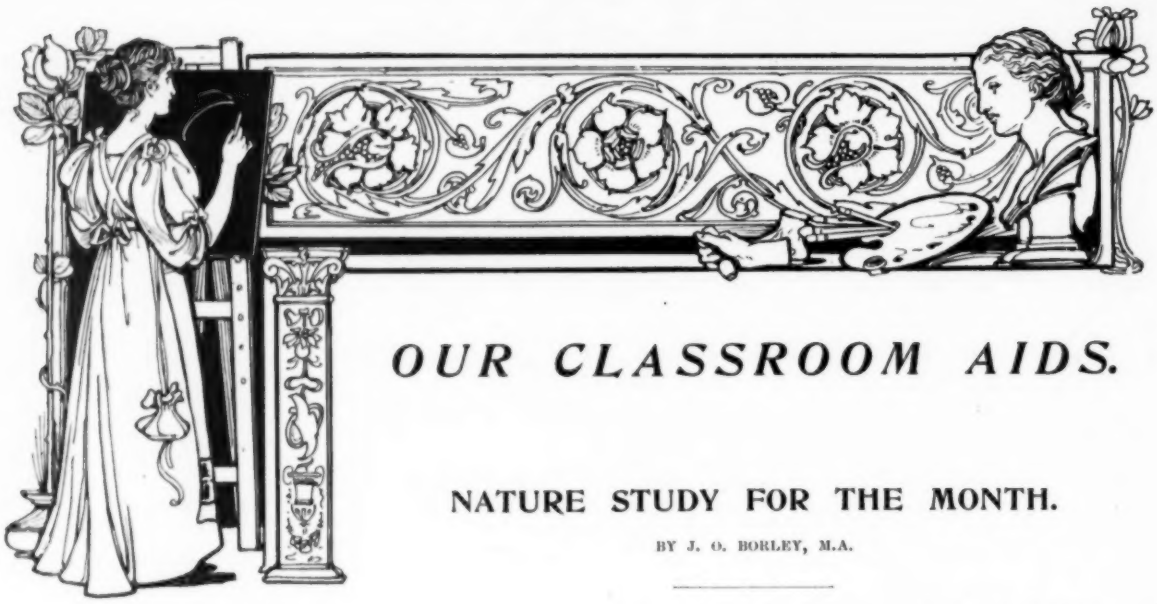
has been absent from school this..... Will you please state the reason on the back of this form, and return it by bearer.

You are particularly urged to send your children in time to school, and on no account to keep them at home, even for half a day, except from unavoidable causes. It is impossible, without regular and punctual attendance, that your children can make satisfactory progress.

I am, yours faithfully,

.....*Head-Teacher.*

GRANTS TO TRAINING COLLEGES.—The Board of Education has issued a circular dealing with the grants payable to training colleges in respect to the instruction given in science and art. For every student instructed in general elementary science only, there will be a grant varying from 35s. to 55s., according to the inspector's report on the equipment and teaching. Should another science subject be taken in addition to the general elementary science, the grant for the latter will be fixed at 35s.; but a grant of equal amount will be paid on account of each student instructed in rural subjects or in advanced science subjects named in the certificate syllabus, except theoretical mechanics or mathematics, for which subjects the grant is only 25s. No student may obtain grants for more than two subjects. The grant for drawing remains at 10s. The circular states that "it is intended that the whole system of grants to training colleges should shortly be remodelled, and considerable changes will probably be made next year with a view to placing the organisation for the training of elementary school teachers and the Exchequer contributions thereto upon a sound educational and financial basis."



OUR CLASSROOM AIDS.

NATURE STUDY FOR THE MONTH.

BY J. O. BORLEY, M.A.

Fog and Mist.

THIS subject is the natural preliminary to the study of rain and rainfall, since rain falls from clouds, and clouds, children cannot too strongly realise, are mere masses of mist. The importance of this community of nature lies in the fact that it explains cloud formation, transformation, and dissipation, and so helps an intelligent reading of the signs of the weather. Some may think the best way to make a class realise what a cloud is, is to take mists and clouds in a single lesson. They are, however, here separated merely for distinctness.

Fog merely differs from mist by consisting of smaller droplets, and, if occurring near towns, holding more solid matter.

Formation { Moist air. / Means of cooling (difference from dew formation). / Nuclei of droplets.

Estimation of relative moisture of air.

It will be as well to start by boiling water in a kettle, or better, by each group of children using test-tubes, and noticing the formation of white clouds of droplets, wrongly called steam, the invisibility of the steam near the outlet, and the disappearance of the clouds where a red-hot poker is put into them. From this alone can be drawn the facts that air can hold invisible water-vapour, that this water-vapour condenses on cooling, that a large solid body is not necessary as a cooler—ordinary cold air answers the purpose—and, lastly, that the hotter air can take up the water as vapour which the colder air had deposited as water.

Similar examples should be dealt with—the more the better. The clouds above an engine's funnel and the condensation of the vapour from the breath on a cold day are legitimate, and the latter has the advantage that the water is not artificially supplied.

We have previously proved that moisture exists in air, and can be made to deposit by cooling it with a can of ice. Natural dew resembles these drops condensing on the can's cold surface, or on the inner surface of a window of a dwelling-room on a cold day, in being due to the cooling of a moist layer of air by a cold solid; but in natural dew formation the solids on which the dew forms are cooled by a different method—namely, radiation; which furnishes the familiar reason for the familiar facts that a clear, still sky, after a hot day, gives most dew (since radiation into space is then unchecked). The moisture so deposited we call dew; the moisture from our kettle we declare to be mist. They are very similar. The moist, warm air at sunset cools. It may deposit dew; it may deposit mist. In either case the essential is that the air should be cooled below the temperature at which the vapour in it is sufficient to saturate it.

While, however, there is one method only of dew formation, there are two of fog formation—namely, cooling by contact and by mixture. It will be most concise to take common instances of each.

Cooling by contact.—1. The great fog-banks of Newfoundland are caused by the warm, moist air becoming chilled by sliding over the cold Greenland current. A point of interest here is that the fog ends suddenly; an excellent illustration of the likeness of fogs and clouds is thus obtained. A ship's bows, for instance, may be in clear sunlight while its stern is completely hidden. For an experiment, the can of ice before referred to may be used again, or a cold slate may be held against the spout of the boiling kettle.

2. Mists on the tops of mountains. This, however, is not a pure effect, being partly produced by cooling on expansion. (See clouds.)

Cooling by mixture.—1. Mist is formed over a stream in very cold weather at night. Here the water cools less quickly than the land, and hence air over water remains warm and moist, and gradual mixture with air over land, or any parting with heat to this air, causes a fog.

2. This instance brings us back to our comparison with dew. It is very common in winter to find a ground-mist extending only a few feet into the air; above, a star-lit sky. Surprise is even expressed at this. Really the second, the clearness of the air, has caused the first. The process appears to be, first, the cooling of the earth by radiation, causing dew deposition, and leaving saturated, chilled air near to the earth; next, some slight motion of the air, causing mixture of this chilled air with the warm air above, and producing mist. This mist, like dew, forms at sunset and disappears as the sun rises. One difference between these seems therefore to lie in the presence of a solid body in case of dew, and its absence in the case of mist and fog. This difference is only apparent. It has been found by Aitken that moist air which has been filtered by passage through cotton wool produces no mist, although cooled; on dust-laden air being admitted to the vessel a cloud immediately formed in it. This experiment suggests an easy method for proving fogs and mists to contain solid particles. Procure a tin can with a tap at the bottom, or a stone jar similarly provided with a tap. Fit the top with a cork through which passes a glass tube about a quarter of an inch wide at least, and bent at a right angle. (The glass can be bent in an ordinary gas flame.) Put clean cotton wool in a loose wad in this tube, and fill the can with water before corking up. Wait for a foggy day, and turn on the tap. The air will rush in to take the place of the water, and in doing so will have to pass through the cotton wool, which soon becomes dirty, showing the presence of solid. A natural case of similar filtration of the fog is seen by the curious state one's eyes and nose get into on a foggy day—the solid particles in the air being caught by

the small hairs at the nostrils and eyes. Instead of a tapped can or jar a large glass bottle can be used, the glass tube filled with wool passing through the cork as before, and in addition another glass tube bent twice at right angles also passing through the cork. If one end of this second tube nearly touches the bottom of the bottle, and the other end is at a lower level, the tube acts as a siphon, and the bottle draws in air. It will be necessary to start the flow by drawing through the tube with the lips.

The small amount of dust so obtained shows it to be quite inadequate to have cooled the moist air, as did our can of ice. Aitken's work, which has been much extended, showed that the function of the dust was to form a centre or nucleus round which the droplets formed, much after the fashion of the growth of our nitre and snow crystals, as previously discussed. It would be going very far to say that no fog, mist, or cloud ever formed without solid particles; yet undoubtedly these latter are mostly present. Their importance in this respect may be illustrated by noticing that the presidential address to the British Association in 1901 adduced the formation of a mist under certain conditions in a moist rare gas as evidence that the gas itself consisted of separate minute particles.

It is not possible to predict accurately the occurrence of a fog; but at least we can tell when it is possible, if we can tell whether the air is nearly saturated or not. The instrument now described is somewhat ineffective, and moreover attempts too much for our present purpose, as it endeavours to determine the water in excess of the amount that would saturate the air at 0°. Still it gives some rough idea of the wetness of the air, so we may quote it for its historic interest. It is sketched in Fig. 1.

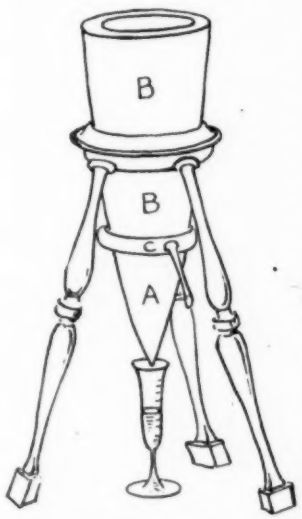


FIG. 1.—After Hellmann. The tip A of the cone alone is of glass, and furnishes the dew. The upper part B of the cone also condenses dew, but this drains off by the gutter C. B was made of cork.

The very small glass vessel was graduated, like all early Florentine instruments, by little beads of glass stuck on its side; the moisture in the air was supposed to be estimated by the time taken to fill this vessel by dripping, when the cone, whose lower part only was of glass, was filled with pounded ice. By substituting a large tin funnel for the cone, after stopping the end of its tube by a cork, with a needle stuck into its lower end, a model is made by which the principle can be shown. The air is cooled by the cold funnel, and deposits moisture, which runs down the outside of the funnel on to the needle, and drips into the graduated vessel. The instrument dates from the year of the Great Fire.

A better attempt at the matter may be thus approached. Procure some deliquescent substance, such as caustic soda, and leave it exposed to the air. This gets wet in a few minutes even in very dry weather, hence it is useless for distinguishing wet air from dry, yet it shows that moisture can be detected by being taken from the air by a body whose properties are changed in the action. If a substance can be found whose properties change very little, dry and wet air can be distinguished, as the effect will be cumulative; and if the substance not only takes water from wet air, but gives water to dry air, it can be used day after day.

Seaweed answers this purpose partly, becoming moist and limp on days when air is wet, as the salt in the seaweed acts in the desired way; but the best substance is a clean human hair. One of the grimmest of scientific observations is expressed by the Xuni Indians of Mexico, who say, "When the locks of the Navajos grow damp in the scalp-house, surely it will rain."

Hair lengthens on absorbing moisture. Fasten, then, a long hair to one arm of a T-square near the join. Stretch it till just taut, by hanging a small weight to its end. Take a long straw, and about one-eighth of the way along tie the weighted end of the hair. Pierce the end of the short arm of straw with a needle, which is then hammered into the flat part of the ruler of the T-square. Work the straw to and fro till it turns loosely on the needle, and fasten a wide strip of card behind the straw. A workable hygrometer is now complete.

Hold it near a steaming kettle; the index sinks. Mark the straw's lowest point on the card as 100. Allow the instrument to dry before a coal fire; mark its highest point as 0. Divide intermediate space into 100 parts. Then when in future the straw's end approaches 100 the air is very wet, and a slight fall of temperature will produce mist or fog, or dew or hoar frost.

Clouds.

Here we have mists formed in the air; again we meet moist air, again find cooling the essential for the formation of mist, and again retain the old causes of cooling—namely, contact with cold body, cooling by radiation, cooling by mixture; and add a new one—namely, the cooling which is the result of air expanding against pressure.

Dealing first with the new feature, we have to prove that air is heated in being compressed, and cools on expanding against air-pressure. Air can be compressed by a small brass pump into a tapped brass vessel, or, as well, a bicycle tyre allowed to slacken by unscrewing the valve, and then pumped up. The *bottom* of the pump in either case becomes hot; which shows that the heating cause is compression, not friction. Now allow bicycle wheel or brass cylinder to cool, and then open tap against a thermometer bulb. A cylinder of oxygen, as used for the optical lantern, can be used if more convenient. The mercury of the thermometer will sink, as a rule, at once; but if the experiment is unsatisfactory, repeat, using instead of the thermometer an air thermometer made by closing the neck of a small flask (say eight ounces) with a cork through which passes a straight, narrow glass tube about twelve inches long, warming the flask slightly, and then placing the end of the tube in water. The resulting instrument has the respectable antiquity of over two centuries, having been used by the famous Florentine, Accademia del Cimento, and is very sensitive. The slightest cooling of the inverted flask produces a rise of the thread of water in the tube.

Having thus proved expansion competent to cool, it is at the same time shown competent to condense; and we have all our data for starting the study of clouds. This cannot, of course, be experimental. It is a matter of observation, and hence furnishes more opportunity for connected record. When the kinds of clouds can be recognised, a daily record should be kept of which kind occurs, on a sheet ruled into columns, marked "clear," "cloudy," "form of cloud," "change of cloud;" and it is well to keep on the same sheet record of the number to which the hygrometer straw points, and whether rain occurs or not. The results show that it will be, after a time, possible to build up an empirical connection between certain cloud forms and moist atmosphere and rain, and to destroy by good evidence the idea that a moist atmosphere always presages rain, and a dry one fine weather.

Clouds readily fall into few types. Some of the chief only are here briefly dealt with. It is suggested that each is best studied on a day when the cloud is visible, and that each child make individual sketches, and copy, for preservation, any good drawing he has made, also a blackboard diagram carefully prepared. If Howard's names, given in 1803, seem unsuitable for children, others can be invented perhaps. Where a common popular name exists it is here given.

I. *Cumulus.*—To understand the formation of this cloud, watch a steamer or railway engine sending steam into the air; little cumuli form over the funnel. A cumulus, then, is the rounded mass of cloud, dome over dome, that presents such magnificent appearances in the full summer sun. Abercromby calls it the "visible capital of an ascensional column

of air." It floats at a medium cloud height—2,000 to 25,000 feet. Condensation caused by expansion at this level means wet air to start with; hence the cloud is prevalent in the tropics, but, except in summer, rare, inland, in Europe.

The weather following cumuli should be found to be either bright and fine or showery. That the tropical cumuli can give rise to heavy rain could be inferred by the Moki rain-charm. To some extent it is possible to predict the weather following cumuli by that preceding it. Thus:—

1. Few cumuli in calm blue sky. Fine.

2. Cumuli wedge-shaped, with lower surface flat, moving towards narrow end of wedge (showing upper condensing current slower than lower one). Showery.

3. Cumuli with turreted upper edge. Thunder, for unknown reasons.

4. Cumuli with lower edge rounded or "festooned." These are cumuli in the process of degradation. The air current has ceased which gave rise to them; the weight of the cloud mass is forcing it down—most, of course, below the thickest mass. Hence the atmospheric conditions are changing. Cumuli with rounded bases therefore portend change. In reality it may be remarked clouds generally are able to give indications of coming weather merely because both weather and cloud form are results of conditions of pressure and motion in the atmosphere. Thus the cumulus (2) is indicative of a certain shower-giving condition, because in that condition upper currents are faster than lower ones. Cumuli reduced to flat cake-like masses, and cumuli appearing, through perspective effect, to be crossed by such masses, have the same indications.

II. *Cirrus.*—Imagine an ascending column, having lost most of its moisture, to reach a higher level, where the almost last traces condense. There will not be enough to form copious masses, but mere feathery wisps; and supposing these are drawn out by the higher current moving more or less swiftly, we have a true cirrus or curl. These are high-level clouds (12,000 to 50,000 feet), and probably consist of ice-spicules.

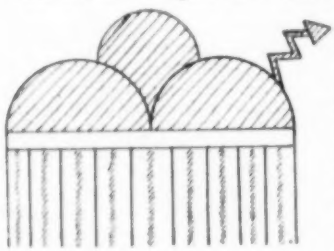


Fig. 3.—After Holmes.

Weather forecast:—

1. Cirrus in evening causing long stripes after a bright, cumulus-laden sky whose cumuli have disappeared. Fine.

2. Cirrus in long, gray, straight fibres. Wind. This is the form known as "mare's tails."

3. Cirro-stratus. Long parallel fibres, resembling mare's tail; thicken; become joined by a stratum or layer on which the original fibres, owing to perspective, appear like converging ridges (Noah's ark sky). Weather sign—rain, which takes place after the cloud has thickened up to resemble a thin flat cumulus (cumulo-stratus).

Thus it will be seen that cirrus, formed from clear sky, is followed by cirro-stratus; this, by rain; this, by showery cumuli.

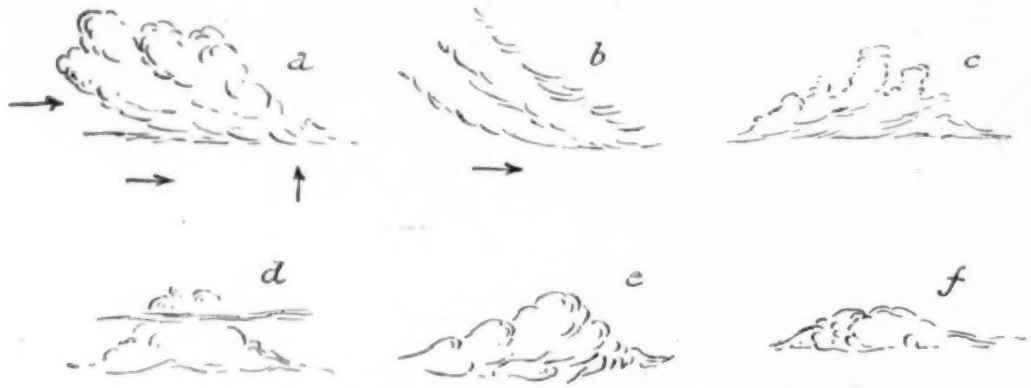


Fig. 2.—After Abercromby. *a*, Cumulus with under current rapid. *b*, True cirrus. *c*, Turreted cumulus. *d*, *f*, Degraded cumuli. *e*, Of the festooned type. Arrows show directions of air currents.

III. *Stratus.*—Cloud of great extent, flat, low, forming very quickly. Probably due to cooling by radiation. The whole air in contact with earth being chilled, chills in turn layer after layer above it, till, a wet layer being reached, a cloud forms. This conjecture fits in well with the fact that the stratus is a fine-weather cloud—that is, is associated with a previously clear sky and a still day. Weather expected—fine. Carefully distinguish between stratus and cirro-stratus.

IV. *Woolpack or fleecy clouds and mackerel sky.*—Both called cirro-cumulus, both fairly high (above cumuli), both have as bases little rounded masses of cloud. The former has a looser texture and a good deal of wispy, fleecy, connecting tissue; the latter is in harder pieces, which are isolated. Both, in England, indicate fine weather.

V. *Nimbus or rain-cloud.*—Any cloud from which rain is falling. Generally low, dark, cumulus edges, top ragged out. The only thing to do is to recognise this cloud afar off. Obviously it accompanies rain.

It need only be said, in conclusion, that the value of the observations and the success in forming conclusions depend very largely on noting change of cloud; and that to keep cloud observations vital, the weather indications should be discovered, not learned, as a rule.

HISTORY DAY BY DAY.

February.

1st. *Non-jurors deprived of their livings, 1690.*—Sancroft, Archbishop of Canterbury, with a few prelates and a large number of clergy, refused to take the oath of allegiance to William and Mary. They were known as Non-jurors, and were by Act of Parliament obliged to vacate their livings on this day.

2nd. *Stephen defeated at Lincoln, 1141.*—The victory of Northallerton had placed Stephen pretty securely on the throne, but he had not the ability to retain what his sword had won. His weakness and extravagance led the barons again to rise in favour of Matilda, and Stephen was defeated and taken prisoner at Lincoln.

Mortimer's Cross, 1461.—After the death of Richard, Duke of York, his eldest son, Edward, Earl of March, hurried from the west, and boldly advanced on London, routing a body of Lancastrians at Mortimer's Cross.

3rd. *Monk entered London, 1660.*—The nation had become utterly sick of the military rule of the Commonwealth; and when, after the death of Cromwell, divisions appeared in the

army itself, the hopes of the Royalists began to revive. The leaders of the Scottish army being jealous of the English, Monk gathered a convention at Edinburgh, and having obtained money and recruits, boldly crossed the Border and advanced to London. Although he came ostensibly to support Parliament against the army, his real purpose was soon evident, and from the moment he entered London the Restoration was assured.

4th. *Coomassie occupied, 1874.*—Rapidly following up the victory of Amoaful, Sir Garnet Wolseley entered Coomassie.

5th. *Sir Robert Peel born, 1788.*—Born at Bury, educated at Harrow and Oxford; Chief Secretary for Ireland, 1812–18; Home Secretary under Lord Liverpool, 1822–27. As leader of the House of Commons, he introduced the Catholic Emancipation Bill, 1829, which led to the overthrow of the Government. He became head of the Tory party in 1841; but his financial policy offended many of his followers, and his proposal to repeal the Corn Laws was defeated, and he resigned. Lord John Russell was, however, unable to form a ministry, so Peel was recalled, and carried his proposal. He died 1850.

6th. *War declared against Tippoo Sahib, 1799.*—The genius of Napoleon in stirring up strife and rebellion made itself felt as far away as India, where Tippoo Sahib, the successor of Hyder Ali in Mysore, vowed to drive the English from the south of India, and recover the possessions he had lost in 1792. Lord Wellesley demanded that Tippoo should give up his alliance with the French, and on his refusal war was declared.

7th. *Charles Dickens born, 1812.*—Dickens was one of the greatest and most original of English novelists. Notwithstanding the tendency to caricature in his writings, the characters in his vast portrait-gallery are, in the main, true to life.

8th. *Mary Queen of Scots beheaded, 1587.*—Probably no event in history has given rise to more discussion than the execution of the unfortunate Mary. It cannot be denied, however, that Elizabeth found herself placed in as difficult a position as it is possible for any one to be in; but although the claims set up by the adherents of Mary would, had they been allowed, have deprived Elizabeth not only of her throne but also of her honour, it was with difficulty that the latter brought herself to sign the warrant. Mary died at Fotheringay Castle as dauntlessly as she had lived.

9th. *Charles the Second's second Parliament met 1626.*—This Parliament no sooner met than it called for an inquiry into the failure of Buckingham's expedition to Cadiz. Charles, however, refused to sacrifice his favourite. "I see," he wrote to the House, "you especially aim at the Duke of Buckingham. I must let you know that I will not allow any of my servants to be questioned among you, much less such as are of eminent place and near to me."

10th. *Treaty of Paris, 1762.*—This treaty between England, France, and Spain brought the Seven Years' War to an end. By it England recovered Minorca and restored Belle Isle; she restored Martinique and Guadeloupe, but retained her other conquests in America. Spain gave up Florida for Havana, and recovered the Philippines. France abandoned all right to any military settlement in India, and also yielded Canada, Nova Scotia, and Louisiana as far as the Mississippi.

11th. *Lord Roberts commenced his advance for the relief of Kimberley, 1900.*—This marks the turning-point in the Boer War. Roberts and Kitchener had arrived at Cape Town, January 10, and had spent a month in silent preparation. Roberts now appeared at Modder River, and commenced his famous advance.

12th. *Lady Jane Grey beheaded, 1554.*—Already imprisoned in the Tower for the ambitious designs of her father-in-law, Northumberland, Lady Jane Grey was now brought to the scaffold by the rashness of her father, the Duke of Suffolk. Taking advantage of the popular feeling against the Spanish marriage, Suffolk had joined Sir Thomas Wyatt in his daring but ill-fated insurrection.

Battle of Herrings, 1429.—So completely had the long series of English victories demoralised the French soldiery, that Sir John Fastolfe, with a handful of archers, was able to repulse a much superior force, and capture the convoy of provisions, chiefly herrings, intended for the relief of the garrison of Orleans.

13th. *Massacre of Glencoe, 1692.*—Sir John Dalrymple, in whose hands the government of Scotland mainly rested, wished to make their resistance to the claims of William an excuse for exterminating the whole of the Highlanders, who had long been a terror to their Lowland brethren. "Your troops," he wrote to the officer in command, "will destroy entirely the country of Lochaber, Lochiel's lands, Keppoch's, Glengarry's, and Glencoe's. I hope the soldiers will not trouble the Government with prisoners." His plans were, however, frustrated by the submission of all the chiefs except Macdonald of Glencoe. The story of the massacre is well known. The Campbells, deadly foes of the Macdonalds, were selected for the ghastly work; and after being quartered in the glen for twelve days, they fell upon their hosts without the slightest mercy.

14th. *Battle of St. Vincent, 1797.*—The naval supremacy of Britain was threatened at this time by a formidable coalition. The Dutch and Spanish fleets were allied with France, with the object of gaining command of the Channel, to enable France to pour her troops into Ireland to assist the Irish insurgents. The danger was averted by the total defeat, off Cape St. Vincent, of the Spanish fleet, which was driven back to Cadiz, with the total loss of four of its finest ships, by Admiral Jervis.

15th. *Relief of Kimberley, 1900.*—With the utmost secrecy, Lord Roberts dispatched a large body of troops, under General French, to relieve Kimberley. Dashing past the left of the Boer position, the British troops entered Kimberley after a fatiguing ride of over a hundred miles.

16th. *Clarendon born, 1609.*—Returned to Parliament 1640, he joined the popular side, and began as a reformer. In 1643 he went over to the king, and was made Chancellor of the Exchequer. After Naseby he went abroad, but on the return of Charles the Second he became Lord Chancellor and chief adviser to that monarch. The Clarendon Code brought on him the hatred of the Puritans, while the Acts of Oblivion and Indemnity made him detested by the Royalists, so Charles had no difficulty in placing upon his minister the odium of such acts as the sale of Dunkirk and the disgraceful conclusion of the Dutch War. He was impeached 1667, but fled to France, where he spent his last years on his History and other writings.

17th. *Battle of St. Albans, 1461.*—After his victory of Mortimer's Cross, Edward of York struck boldly upon London. He was opposed and, after a desperate struggle, defeated by the Lancastrians under the Earl of Warwick. Had Margaret advanced to London immediately, the struggle might have been decided; but while she stopped to take vengeance on her enemies, her army scattered in search of pillage, and Edward was enabled to collect his forces and enter London.

18th. *Blake defeated Van Tromp, 1653.*—Since the downfall of Spain, Holland had been the first naval power in Europe, but a serious blow was dealt to her carrying trade by the Navigation Act, and war became inevitable. Holland strengthened her fleet, and was at first victorious; but in February Blake again put to sea, and a running fight of four days ended in the defeat of Van Tromp, although he was even then able to save the convoy he was protecting.

19th. *Battle of Northampton, 1460.*—The birth of a son to Henry the Sixth having destroyed the hopes of Richard, Duke of York, as heir presumptive to the crown, he asserted the claim of priority to Henry himself, as being descended on his mother's side from Lionel, the elder brother of John of Gaunt. He was compelled to take refuge in Ireland, but taking advantage of a general rising in Kent and the southern counties, he returned and defeated the royal army at Northampton, when Henry was taken prisoner, and Margaret was forced to flee to Scotland.

20th. *De Montfort's Parliament, 1265.*—This day saw one of the greatest constitutional changes in the history of our country. After the defeat and capture of Henry the Third at Lewis, De Montfort summoned Parliament; but so jealous were the barons of De Montfort that only twenty-three attended. This weakness compelled De Montfort to summon two knights from every shire, and also two citizens from every borough. Thus, for the first time, the merchant and the trader took their share in the government of the realm.

21st. *Trinidad taken, 1797.*—This island was discovered by Columbus in 1498, and was colonised by the Spaniards, 1588. It capitulated to the British under Abercromby, 1797, and is now a crown colony.

Gujarat, 1849.—This brilliant victory terminated the Second Sikh War, and led to the annexation of the Punjab.

22nd. *George Washington born, 1732.*—In 1775 he was appointed commander-in-chief of the forces raised by the American colonists to resist the mother country. In 1787 he was elected president of the convention that drew up the national constitutions, and two years later he became the first President of the United States. He died 1799.

23rd. *Arrest of Cato Street conspirators, 1820.*—The conspirators intended to assassinate Lord Castlereagh and other ministers. One of the gang betrayed the plot to the police, and Thistlewood and four others were hanged.

24th. *The English defeated at Roslin, 1303.*—In spite of his victory at Falkirk, Edward only remained master of the ground he stood on, and the Scottish nobles under Bruce and Comyn still continued the struggle for freedom. The latter routed a superior English force near Roslin.

25th. *Death of Sir Christopher Wren, 1723.*—Originally professor of astronomy at Gresham College, he was appointed Royal Surveyor in 1668. After the Great Fire, the task of preparing the plans for rebuilding St. Paul's Cathedral was intrusted to him, and occupied him fifteen years.

26th. *Victor Hugo born, 1802.*

27th. *Battle of Majuba, 1881.*—Affairs in South Africa are too much in the region of party politics to discuss here the causes of this war, whose series of disasters culminated in the defeat and death of Sir George Colley on Majuba Hill.

Surrender of Cronje, 1900.—Realising his danger too late, Cronje commenced his retreat to Bloemfontein. French, however, intercepted him; and finding himself surrounded on all sides, the Boer leader intrenched himself at Paardeberg, and held out for some days. Finding escape impossible, the whole force, numbering over four thousand men, surrendered.

28th. *Relief of Ladysmith, 1900.*—The success of General Buller, after repeated failures, and the terrible sufferings of Sir George White and the gallant defenders of Ladysmith, are too fresh in the minds of every one to need enlarging upon.

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

Village Schools and the Education Act.

The Levelling up of Rural Districts. One of the most important effects of the new Education Act will be the improvement of the rural schools. In most respects educationally the villages lag behind the towns. The rural exodus is thus stimulated from within. The village primary school of the future is to offer educational facilities which shall satisfy the most exacting demands.

The County Committee will regard the matter more seriously than the five-membered School Board has been wont to do. The Committee will find much to do outside and inside the schools.

Common Defects in Village Schools. I have been visiting several country schools lately where the playgrounds are veritable marshes. Some I have been unable to cross, the mud being several inches deep, and in others I have found stones dangerously projecting. Some cement and stones mixed would form a useful covering for most of these places. Inside, some attention is needed to the heating of the buildings. In towns one rarely has to complain on this score, as there is generally good heating apparatus. In the country frequently there is no stove, and on cold days the temperature is down at 40° F., or below. A slow-combustion stove, properly lined, would be found useful, and care should be taken not to place it in the middle of the schoolroom. The stove should invariably be protected by a substantial guard.

Many of our village schools are not well lighted. This is sometimes due to the opaque glass windows. In such cases it would be well to replace the opaque by transparent glass. In other cases the difficulty may be obviated by inserting skylights or by enlarging the present windows. There are in some places wooden partitions which darken classrooms. If in the upper portions of these partitions glass panes were inserted the effect would be beneficial.

The Furniture of the School. The furniture is often far from modern. The desks have their seats several inches back from the edges, instead of being flush with them. Oftentimes all the desks of the school are of the same height, instead of being graded to correspond with the varying ages of the scholars. They do these things differently in America. The special correspondent with the Moseley Mission, writing recently in praise of the equipment of schools, says in reference to a typical primary school: "Each child had a separate seat and desk, and was much better provided for in every way than children in the same class of school in England. The children seemed to take an immense pride in keeping their small possessions in spick and span order, and according to the teachers the system has an excellent effect on the general discipline of the classroom."

I should strongly recommend managers who are providing new desks to consider the advisability of having separate ones with lockers for, at least, the eldest children in the school.

How Infants are Catered for. In village schools the equipment for the infants is often unsatisfactory. The small space available is generally partially occupied by a cumbersome gallery—a relic of the good old days when kindergarten games were not. The galleries might very well be dispensed with in most cases. Far from assisting in, they militate against good discipline. The children are perched up in a position to see all that is going on, and once up there, are seldom allowed to come down during the session. Suitable infant desks and little chairs will be found more useful than the platforms. There will be more room to carry on the games and other portions of the curriculum of a modern infant school.

Under the County Committee we shall find, it is to be hoped, the schools cleaner and tidier.

Caretaking on the Cheap. Owing to the present intolerable strain, the caretaking is often of a very shifty character. Sometimes the teacher lights the fires and dusts the school; sometimes scholars undertake these duties. The untidy schoolrooms make a lasting bad impression upon the scholars. The schoolroom should be scrupulously clean and free from litter. It is as essential for the scholars to learn to be tidy and clean as for them to become expert arithmeticians.

Early Dismissal Advisable. At a country school the other day I found that in the winter the children reassemble in the afternoon at 1 p.m., and are dismissed at 3.20 p.m. This is a practice I should commend to the notice of all teachers whose scholars come long distances along country lanes. Most of them stay in to dinner, and so there is no need for a longer interval than one hour. In the winter it is important that all should reach their homes before dark.

THE "NOTEBOOK" QUERY COLUMN.

Letters intended for this column should be addressed "Inspector," care of Editor, PRACTICAL TEACHER. Only in very urgent cases can replies be sent by post, and then only when two stamps accompany the letter.

A.J.W. writes: "In November 1901 the Board of Education issued a circular offering to those First-Year (1901) Students who were successful in one part only permission to sit for the Second-Year Certificate Examination in 1902. Can you give me any information respecting the above?

Answer.—I have searched, but find no trace of such a circular. It would have been addressed to the Principals of Training Colleges, so I advise you to write to one of the principals asking for the information.

E.R.W. is a pupil teacher whose engagement ends June 30, 1903, and asks:—

1. If I do not pass high enough for college in 1902, shall I be allowed to try in 1903 if I leave school in June 1902?

Answer.—Yes.

2. By not being engaged in teaching from June to December, shall I forfeit the marks obtainable for practical teaching?

Answer.—Ask the inspector to give you your teaching marks before you leave.

M.L. writes: "If a teacher who wishes to sit for the 1903 Certificate Examination omits the drawing specified in the regulations, will she fail?

Answer.—Extract from official reply to a correspondent: "It is possible for a candidate to pass the Certificate Examination without offering the subject of drawing, but he would naturally prejudice his position by forgoing the marks which might be obtained for it."

L.P. writes: "Is the Advanced Physiography (Optional Course) Examination (Certificate 1903) to be taken on 11th May (evening) or 25th June (day) as an ordinary advanced science, or is it a special examination having a special date?

Answer.—The examination referred to is the ordinary Advanced Science and Art Examination.

Ida wishes to know of suitable books on botany and zoology for the Certificate Examination (1904).

Answer.—It is impossible to procure *cheap* serviceable books on these subjects. There are at present few books suitable. It would be well to consult your tutors.

For first books in elementary biology you might try Bailey's *Lessons with Plants*, 7s. 6d., and *Introduction to Zoology*, by Davenport, 6s. (Macmillan).

W.R. desires information as to the syllabus of the Froebel Union Examinations.

Answer.—Write to the secretary, National Froebel Union, 4 Bloomsbury Square, London, W.C.

I know of no correspondence class, but possibly the secretary could tell you of one.

X.Y.Z. asks whether it is necessary to read and recite when going up for the examination to qualify for the superintendence of pupil teachers.

Answer.—It is now necessary for such persons as desire to raise their certificates to obtain a fresh report under Art. 57 (*d*). This is occasioned by the abolition of the two parts of the examination.

A LESSON ON THE STUDY OF A PICTURE.

"THE INSIDE OF A STABLE" (George Morland).

BY FRANCIS J. FROST, B.A. (OXON.),

Head-Master, Pupil Teacher Classes, University College, Reading.

(See Supplement presented with this number.)

Aims.—1. To secure precision in description.

2. To exercise inference and imagination.

3. To further extend interest in pictures.

I. Preparation.—If the three previous lessons of this series have been given as suggested, there need be little "preparation" now. It should suffice merely to draw attention to this picture, when suitable ideas would naturally come into consciousness. After allowing a short time for examination of title and general character of picture, proceed at once to the next step.

II. Presentation.—1. An examination of the elements.

(*a*) Let the pupils point out all the different parts of the picture, the teacher noting, as before, whether the more important strike the eye and are mentioned first.

(A white horse, another horse, a pony; a man and a boy; an ordinary stable, with its usual accessories.)

(*b*) Let the pupils describe carefully the position of the three animals, and that of the two persons.

(The white horse stands nearly at the centre of the picture. It appears to have just got inside the stable. The other horse is outside, but appears anxious to enter; while the pony is almost inside. The boy appears to have just led in the white horse. He stands at its head, and the direction of his eyes leads one to the man, who is kneeling on one knee as he gathers up the hay which is evidently to provide the coming meal.)

2. Interpretation.

(*a*) Let the pupils study the attitude of the three animals, and infer the meaning which the artist intended to convey.

(The important matter, so far as the horses are concerned, is the meal. The white horse is evidently controlling his eagerness with some difficulty; while the other, who is at present almost outside the stable, but who scents the hay, is making considerable efforts to come near the food. In contrast with these stands the pony. He does not appear to have been hard worked. On the contrary, he seems quite contented, and the scented food seems to have little or no attraction for him.)

(*b*) Pupils might now be invited to describe the two persons in the picture by supplying answers to the following questions:—

(1.) What is the relation between these persons?

(Evidently the man is the carter and the boy his assistant. The latter stands by ready, though not very willing, apparently, to do what may be ordered him.)

(2.) Describe the dress of the carter and that of the boy.

(In attempting to do this the pupils will probably notice the absence of detail, especially in the case of the boy. This skill of the artist, who could express so much by means of a few swift strokes, should be referred to later.)

(3.) Infer the character of the boy by a study of his attitude and his general appearance.

(He is wanting in energy, and in this respect stands in contrast to the two horses and the carter. Like the pony, he appears unconcerned, except that he takes an idle interest in the preparation of the horses' food. The shuffling gait, the stooping figure, the heavy look, and the general appearance of irresponsibility, all combine to produce the typical rough, uneducated farmer's boy.)

3. Comparison.

(*a*) Pupils are to mention in what respects this picture corresponds with those already treated.

(1.) The white horse, which first attracts attention, is placed in the centre, and is in the high light.

(2.) The eagerness of the horses and the look of the boy constitute the dumb show which indicates the simple meaning of the picture.

(3.) The dim-lighted stable contrasts with the bright light without, and the suggestion of green fields and pleasant trees; while the white horse stands out very prominently against its gloomy surroundings.

(4.) The stable shows an artistic disorder.

4. Contrasts.

Let the pupils discover, so far as they are able, in what respects this picture differs from those already studied.

(1.) This is pre-eminently a study of animal life.

(2.) This picture is lacking in the refinement and delicacy which were so noticeable in "The Angels" and "The Last In."

(3.) There is an absence of detail, but the bold, swift strokes are full of power and suggestion.

(4.) There is no great effort of the imagination in the composition of this picture. Morland here shows that "truth is beauty," and without much embellishment he "holds the mirror up to nature."

III. Association.—In addition to those which occur in the Presentation—

1. Other famous animal painters and their pictures might be referred to—for example, Landseer, Weir.

2. With the fact that artists do not merely "hold the mirror up to nature," but put into their pictures something of themselves, may be compared the fact, in literature, that writers (outside the naturalist school) do not give a mere photographic view of human life such as can be seen in the police news.

3. The "artistic disorder" makes for naturalness. In everyday life we dislike too much precision and stiffness in decoration.

IV. Formulation.—Perhaps the best formulation on this lesson would be for the pupils to write a summary of what they have been taught during the Presentation. This done, they might be set to find out what it is they like in this picture, giving, if possible, their reasons.

V. Application.—1. Let pupils try to find out from this

picture and from remarks made during the lesson something of the character of the artist.

(The students should, of course, be warned against hasty generalisation, but they may be informed that this is a typical picture. The following inferences might be made:—

(1.) Morland loved painting animals.

(2.) He was wanting in refinement.

2. The life of Morland might be looked up for a future discussion, but the pupils should be advised that there is considerable difference of opinion as to the sort of man he was.

3. The pupils might like to apply what they have now learned in inferring—The time of day, season of year, nature of horse's work, the artistic value of the boy's arm and the small wheelbarrow in the picture.

4. Students should be recommended to see the original picture in the National Gallery.

The following is given as a specimen of the sort of "application" which young pupils might be expected to make after one or two lessons. It is an essay on a picture not previously studied.

ESSAY ON A PICTURE

Entitled, "Thou art so near and yet so far."

This picture, which was painted by a lady named Clara Wicks, shows us a fox sitting on one side of a stream and a rabbit on the other. The expression on the face of the fox is one of extreme slyness. The face of the rabbit wears a look of triumph. Most probably the fox is thinking, "Could I but cross that stream I should have a nice meal;" while, on the other hand, the rabbit is feeling quite secure from the attack of his enemy, and is regarding the fox with a look as much as to say, "Ah, Mr. Fox, you've been done this time."

The picture attracts attention by the amount of light and shade which it contains. The sky overhead is beautifully clear and white, and this is reflected in the water, together with the shadow of the trees which are hanging over the stream.

The eye first rests on the sly old fox as a whole, then one looks at his eyes, and they naturally lead us to the rabbit. Then one thinks, "Why is the fox not attacking the rabbit?" and the attention is drawn to the intervening stream. In the stream we see the reflection of the trees, and the eyes are then led to the objects which are reflected—namely, the trees.

This picture arouses a feeling of happiness rather than gloom. We are pleased to think that the fox has been robbed of his prey, and that the life of the rabbit has been spared for the present.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

VENEZUELA.

SOUTH AMERICAN republics possess an unenviable reputation for ferment and general unrest, with occasional revolutionary upheavals that paralyse financial stability and endanger commercial and economic progress generally. Venezuela, in this respect, has been no better than any of her neighbours, and considerably worse than some of them.

History.—Alonzo de Ojeda, a Castilian knight who had accompanied Columbus on his second voyage, appears in the year 1499 to have cruised along the coast from the mouth of the Orinoco to the Isthmus of Panama with a fleet of four small vessels.

King Ferdinand made Ojeda governor of all the north coast of South America, but he returned bankrupt and broken-hearted to San Domingo. For forty years the natives resisted Spanish domination, until Charles the Fifth decreed that the aboriginals should be reduced to slavery. Every captured man, woman, or child was branded with hot irons upon the forehead with the monarch's initial; and the whole coast was dyed with the blood of the people in defence of their homes and liberty.

For two and a half centuries Venezuela remained loyal to the crown of Spain, notwithstanding the selfish and oppressive form of government. No privileges or liberties were allowed to remain with the people; they were not permitted to engage in trade with any country other than Spain; the chief exports were Government monopolies; all surplus products were sold to the Spanish officials at their own valuation; no schools were allowed outside the monasteries and convents; and the importation of books was forbidden, except by special permission of the governor. "In fact, the history of Venezuela, since that beautiful land was discovered, has been a prolonged series of cruelties, massacres, wars, and revolutions, with brief intervals of peace and prosperity. It has been the most turbulent of all the Latin-American republics, and although the scene of the first civilisation upon the American continent, and the first to declare for civil liberty, its people have been allowed to enjoy very little of either." Groaning under such a policy of repression, little wonder that the dawn of the nineteenth century found the people of Venezuela in a state of the densest ignorance, with exasperated patriots eagerly awaiting the opportunity of raising the standard of rebellion.

To Simon Bolivar, the Washington of South America, belongs the credit of freeing Venezuela from the grinding tyranny of Spain. Bolivar had received a European education, and having also travelled in the United States, he became deeply imbued with the spirit of independence and an anxious desire to promote the welfare of his country.

In April 1809 a *junta*, or legislative assembly, was formed at Caraccas, and similar bodies were elected in other portions of the Spanish possessions. The struggle for liberty was marked by alternate successes and disappointments, but nowhere was the contest so bloody or protracted as in Venezuela, chiefly owing to the country, from its position, being the key to the whole. At last the patriots gained a decisive victory at Carabobo in 1819, and four years later the Spaniards were finally expelled. Bolivar was the first president of the new republic of Colombia (New Granada and Venezuela), and he devoted all his energies and means to the establishment of law and order, and to securing from other countries the recognition of the independence which had been largely achieved by his own colossal exertions.

In 1830 Venezuela seceded from the other members of the Free State, and adopted a form of government similar to that of the United States, with the exception that the provincial and local governments possess a larger share of independence. For fifteen years the country enjoyed comparative tranquillity, and then commenced a series of civil wars and revolutions which continued more or less until 1870, when Don Guzman Blanco became president. From that time Venezuela made rapid strides in orderly development, notwithstanding a certain spirit of unrest so foreign to European constitutions.

Venezuelan Boundary.—For many years the exact limit of the boundary abutting upon British Guiana was a matter of constant dispute. Venezuela based her claims on those of Spain, to whose rights she succeeded on gaining her independence. Great Britain claimed the boundary marked out by the Dutch, who ceded the colony in 1814. In 1899 the matter was definitely settled by arbitration. Venezuela established her claim to the Cuyuni gold-fields, but failed in respect of other claims concerning an area of quite 60,000 square miles.

The Latest Imbroglio.—Internal troubles of more recent origin have brought Venezuela under the displeasure of several of the Great Powers—Great Britain and Germany being chiefly interested.

British Complaints.—1. The Venezuelan Government has seized and destroyed British vessels suspected of smuggling.

2. Two British railway companies cannot obtain payment of £320,000 and £68,000 respectively. In the first case the debt is in respect of a Government guarantee of £41,000 per annum. Originally the payment was at the rate of seven per cent. This was eventually reduced to five per cent., but no portion of the guarantee has yet been obtained.

"THE INSIDE OF A STABLE" (GEORGE MORLAND).

28 JA 1905

In the second case the railway has been in the hands of the Government and also a revolutionary party, for both of whom the company has worked under compulsion.

3. A mixed commission is necessary to settle other claims.

4. Arrangements are needed concerning the foreign debt.

The claims of Germany are in the main similar to those of Great Britain.

In 1901 the Venezuelan Government decreed a commission consisting solely of Venezuelan officials. This, however, failed to meet with the approval of the Powers, especially as the commission was not to be allowed to deal with any claims originating before the presidency of General Castro, who only came into office in October 1900.

President Castro's contumacy has caused British and German war vessels to blockade his coasts. The situation is one of extreme difficulty. Neither of the Powers would care to undertake a punitive land expedition, for the terms of the Monroe doctrine forbid any territorial seizure without bringing about the intervention of the United States. Probably diplomacy will settle the difficulty. The whole of the claims which Venezuela is resisting do not amount to more than £2,000,000. This is not a large sum, but the country is so impoverished that it cannot give security for the amount.

The Country and its Productions.—The total area of the country is about 590,000 square miles, or about as large as France and Germany together. The population is 2½ millions, of whom only 44,000 are Europeans. The greater part of the country consists of the basin of the Orinoco, with its extensive fertile savannahs or llanos. Three distinct zones mark the surface of the country—the agricultural, the pastoral, and the forest zone. About one-fifth of the population engage in agricultural pursuits. The chief products are *sugar-cane*, *coffee*, and *cocoa*. The forest regions yield *caoutchouc*; *tonga beans*, which yield materials for perfumes and snuff; *copaiba*, a medical balsam; and *vanilla*. There are about 30,000 coffee estates, 11,000 sugar, and 5,000 cocoa. Over 50,000 tons of coffee are exported annually. The country is rich in metals and minerals—*gold*, *silver*, *copper*, *iron*, *coal*, *lead*, *tin*, etc. There is a good supply of *petroleum*, and there are vast *asphalt* lakes awaiting exploitation. There are no industries. All manufactured goods are imported; even the sacks in which Venezuelan produce is exported are obtained from abroad.

Communications.—Roads are practically non-existent, except in the neighbourhood of the large towns. The trade of the interior is carried on chiefly by means of pack-animals and small mule carts. There is much steamboat traffic on Lake Maracaibo. There are nearly 600 miles of railway in operation. The chief line extends from La Guaira to Caraccas, and thence to Puerto Cabello. The line from the coast to Caraccas is one of the most remarkable in the world. The direct distance between the two cities is about six miles. To compass this space the railway ascends some 5,000 feet, and then descends 11,000 feet on the southern slope of the range where Caraccas is situated; the total distance by rail is twenty-six miles. The line is little used by passengers, and even mail-bags are frequently carried over the mountains by messengers to expedite delivery.

Towns.—The largest city is *Caraccas*, the capital, with a population of 75,000. It is in many respects a remarkable city. Earthquakes have played havoc there on many occasions; that of 1812 was the most disastrous, when 12,000 lives were lost. The houses possess thick *adobe* walls, and having but one story are practically earthquake proof. Caraccas has made but little progress since Sir Francis Drake audaciously plundered the city of $1,000,000, while the male inhabitants were awaiting his advent in another direction.

La Guaira presents almost the same aspect as it did when it "was a favourite target for pirates, freebooters, and British fleets. It has been captured and looted again and again, and several times partially destroyed." Its chief characteristic is its odours, which in their vileness are only equalled in China. Other towns in order of population are Valencia (38), Maracaibo (34), Barquisimeto (31), Barcelona (12), and Ciudad Bolivar (11).

PHYSICAL TRAINING.

A PROGRESSIVE COURSE FOR ELEMENTARY SCHOOLS.

BY H. RIPPON-SEYMOUR, A.C.,

Chief Instructor, George Watson's College, Edinburgh; Member International Congress of Physical Education, Paris, 1900; Author of "Physical Training," etc.

[ERRATUM.—In Second Lesson, Ex. 26, "Four," the words "as in Two" should be omitted.]

NOTE.—The military commands given throughout this course are almost exactly in accordance with the commands in the *Infantry Training, 1902*, and the *Model Course*, except where experience has shown a modification desirable. The alternative command will generally be shown in a footnote, and the teacher is at liberty to adopt either.

THIRD LESSON.

Military Drill (Second Stage) and Physical Exercises.

(The words of command are in heavy type.)

31. **"In Two Ranks—Fall in."**—One half of the pupils will place themselves in the front rank as directed for one rank (Ex. 1), and the other will form a second rank two paces (48 inches) behind the front rank. These ranks are called respectively "Front" and "Rear." Each pupil of the rear rank will place himself immediately behind a pupil of the front rank without leaving blank spaces. Should the class consist of an uneven number, the third place from the left of the rear rank will be left blank, the front rank pupil consequently having no partner.

"OPENING OUT" IN TWO RANKS (SECOND METHOD).

32. **"Open out—March."**—On the word "March," the

odd numbers of the front rank will take two paces forward, and the *even* numbers of the rear rank two paces to the rear. Four ranks or rows will thus be formed at an interval of two paces between each rank. By turning the class to the right (or left) sufficient room for exercising the arms will be obtained. To close the ranks, give the command, "**Re-form ranks—March,**" when the odd numbers step back, the even numbers forward.

33. "**About—Turn.**"—On the word "Turn," the pupils will turn a *half-circle* to the right in the same manner as already described for "Right—Turn" (9). This turn must always be made to the right, never to the left.

"**Class—Front.**"*—Turn to the original front by the right, as described above.

MARCHING IN FILE.

"**Right (or Left)—Turn.**"—As before described.

When standing in "file," the pupils must cover each other exactly, so that the teacher, standing in front of *No. 1*, will perceive two perfectly straight lines. These straight lines must be preserved whilst marching, except, of course, whilst wheeling at corners.

"**Quick—March.**"—The whole class will step off as directed in No. 12, each pupil endeavouring to maintain his correct distance from the one in front. Each rear rank pupil must keep in line with and about 24 inches from his front rank partner during the marching.

To prove the marching, the class should occasionally be commanded to "*Halt*," when, if it has been correctly performed, the dressing, the distance between each pupil, and the covering of each pair, will be found correct.

FORMING FOURS.

34. "**Form—Fours.**"—On this command the even numbers of both ranks will (1) take a pace with the left foot straight to the rear, and (2) without pause a pace to the right with the right foot (which will bring them behind the odd numbers), and then (3) place the left foot against the right. If the movement has been performed correctly, the class will present the appearance of "sections" of fours.

With young pupils it is advisable to perform this movement part by part, or "*by numbers*," using the words One, Two, and Three, as shown above.

35. "**Class—Front.**"†—On the command "Front," the even numbers (1) take a side pace to their left with the left foot, (2) a pace to the front with the right foot, and (3) close the heels, resuming their former place in the ranks.

When the movements are learned to the satisfaction of the teacher, they should be performed consecutively in quick time.

FORMING FOURS TO A FLANK.

"**Form—Fours.**"—As before described.

36. "**Right**" (or "**Left**").—The class will turn in the direction ordered.

37. "**Class—Front.**"‡—The whole class will first turn to their front, after which the even numbers will without hesitation move into their places in line, as before described.

MARCHING IN FOURS.

In marching to the right or left flank in "*fours*," the greatest care must be taken that each section maintains its correct distance from that immediately in front, and each section must form a perfectly straight line. In wheeling at corners the pupil on the *inner* flank must "mark time" (13) for four paces, gradually turning a quarter circle whilst so doing, in order to allow time for the outer flank pupil to come round, so that on the completion of the "wheel" all may go forward together.

THE DOUBLE MARCH.

38. "**Double—March.**"—The class will step off together with the left foot, running lightly on the fore part of the feet only, the heels not being allowed to touch the floor, and making as little noise as possible. The arms should be allowed to bend until the hands are a little higher than the waist, the fist clinched.

Whilst running, the arms may be allowed to move a little from the shoulders, close to the sides. The pace should, of course, be longer than for the "quick march," 30 inches being probably sufficient for pupils between ten and thirteen.

The feet must be carried well to the front on leaving the ground, and must not be allowed to be thrown up behind.

39. "**Class—Halt.**"—The word "Halt" should be given as the right foot meets the floor, the class then taking one pace with the left foot, another with the right, the left foot completing the movement by closing the heels. Two paces are thus taken after the word "Halt" when "doubling," the closing of the heels making a third movement.

PHYSICAL EXERCISES.

40. "**Arms raising, astride—One.**"—At the word "One," move the right foot as before described (20); at the same time raise the arms sideways above the head, until the backs of the hands meet. As the arms are raised, the head should be thrown slightly backward, eyes directed upward (Fig. 1).

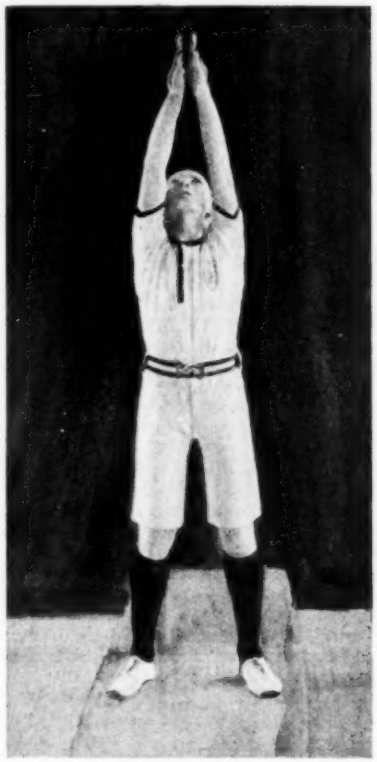


FIG. 1.

"**Two.**"—Lower the arms sideways, and bringing the right foot back to the left, resume the position of "attention."

Repeat until eight or sixteen movements have been performed.

41. "**Arms swinging—One.**"—Keeping the arms straight, swing them quickly to the front and above the head, palms of the hands inwards and about ten inches apart.

"**Two.**"—Bring the arms smartly downward until horizontal from the shoulder, palms of the hands still at the same distance apart and inwards, and without any pause swing them straight and quickly back in line with the shoulders, palms downward (Fig. 2).

"**One.**"—Swing the hands forward and upward as before described. Repeat as often as desired—probably twelve or twenty times.

* "**About—Turn.**"—*Infantry Training, 1902; Model Course, 1902.*
† "**Re-form two—Deep.**"—*Infantry Training, 1902; Model Course, 1902.*
‡ "**Left (or Right)—Turn.**"—*Infantry Training, 1902; Model Course, 1902.*

42. "**Steady.**"—Drop the arms smartly to the sides as in "attention." This command may be used whenever it is necessary to stop a class, either during or at the end of an exercise.

GYMNASTIC MARCH (No. 1).

"**Quick—March.**"—As before (12).

43. "**On the toes—Rise.**"—On the word "Rise," the pupils will place the "hands on hips" (15), and at the same time rise as high as possible on the toes, keeping the knees straight. The length of pace must be reduced to about twelve inches, but the same cadence will be observed as in the "quick march." Owing to the legs being kept straight, the slight spring necessary for each forward movement must be obtained by a "lift" of the instep. The constant practice of this movement will tend to remove flat-footedness.

44. "**Quick time—Quick.**"—On the word "Quick," which should be given as the right foot meets the ground, the

FIG. 2.

pupils will drop the hands, beat the left foot smartly, and resume the ordinary march.

The author will be pleased to answer in these columns questions of general interest on drill and physical training. Letters should be addressed to the **Author, care of the Editor,** *and must enclose the coupon on back page of cover.*

A PLEA FOR THE PRODUCT.

BY C. W. CROOK, B.A., B.SC.

Schedule I.—Arithmetic, Standard V.: "Practice, bills of parcels, and single rule of three *by the method of unity.*"

The introduction into the Code of the words in italics has resulted in the general abandonment of the old method of ratios—a method which, with a little more difficulty in teaching, possesses a great advantage in brevity, and has developed a worship of the unity method which has almost become fanaticism. We propose to show a few cases in which the unity method is generally used at the expense of much unnecessary work, which could be saved by the utilisation of the *principle of products.*

I. CISTERN SUMS.

One tap fills a cistern in 5 hrs.; another empties it in 7 hrs. In what time will it fill with both taps open together?

By *products*, $5 \times 7 = 35$.
In 35 hrs. first fills 7 times.
In 35 hrs. second empties 5 times.
∴ filled *twice* in 35 hrs. and *once* in $17\frac{1}{2}$ hrs.
By *unity method.*
First tap fills in 5 hrs.
∴ first tap fills $\frac{1}{5}$ in 1 hour.
Second tap empties in 7 hrs.
∴ second tap empties $\frac{1}{7}$ in 1 hour.
∴ $\frac{1}{5} - \frac{1}{7} = \frac{2}{35}$ is filled each hour.
∴ $\frac{1}{35}$ is filled each $\frac{1}{2}$ hour.
∴ $\frac{35}{35}$ is filled each $\frac{35}{2} = 17\frac{1}{2}$ hrs.

The advantage of the system of products or multiples increases with the number of taps; for example—

3 taps fill respectively in 2, $3\frac{1}{2}$, 5 hrs.; 2 taps empty respectively in 3 and 4 hrs. Find time of filling if all are open together.

2, 3, $3\frac{1}{2}$, 4, 5 = 420.
In 420 hrs. 3 taps fill 210 + 120 + 84 = 414 times.
In 420 hrs. 2 taps empty 140 + 105 = 245 times.
∴ result, filled 169 times in 420 hrs.
Once in $\frac{420}{169}$ hrs.
Now work out this same sum by the unity method.

3 taps fill in 1 hour $\frac{1}{2} + \frac{1}{3\frac{1}{2}} + \frac{1}{5} = \frac{35 + 20 + 14}{70}$.

2 taps empty in 1 hour $\frac{1}{3} + \frac{1}{4} = \frac{4 + 3}{12} = \frac{7}{12}$.

∴ 5 taps together fill $\frac{35 + 20 + 14}{70} - \frac{7}{12}$ in 1 hour

$$= \frac{420 + 240 + 168 - 490}{840} \text{ in 1 hour}$$

$$= \frac{338}{840} \text{ or } \frac{169}{420} \text{ in 1 hour.}$$

∴ they fill $\frac{1}{420}$ in $\frac{1}{169}$ hrs., and $\frac{420}{420}$ in $\frac{420}{169}$ hrs.

II. A, B, AND C PROBLEMS.

A + B do a piece of work in 5 days, B + C do a piece of work in 6 days, A, B, C do a piece of work in 3 days. How long does each take alone?

In 15 days A + B do it 3 times.
In 15 days A + B + C do it 5 times.
∴ C does it twice in 15 days and once in $7\frac{1}{2}$ days.
In 6 days B + C do it once.
In 6 days A + B + C do it twice.
∴ A does it once in 6 days.
In 30 days (multi. of $7\frac{1}{2}$, 6, and 3) A does it 5 times.
C does it 4 times.
A, B, and C do it 10 times.
∴ B does it *once* in 30 days.

III. EXCHANGE OF QUANTITIES AND PRICES.

For example—I buy eggs at 13 a 1s., and sell them 9 for 10d. What do I gain by selling 300?

Product of quantities = 13·9.
13·9 at 13 a 1s. = 9s.
13 9 at 9 for 10d. = 10s. 10d.
∴ gain on 117 = 1s. 10d.
And gain on 300 = $\frac{300 \times 22}{117}$d.

IV. EXCHANGE OF STOCK (*really same as above*).

A. Which is better investment for £10000: 3 % at 91 or 4 % at 119, and what is the difference in income?

Product = 91 × 119.
£91·119, first investment, gives 119 × 3 = £357 income.
£119·91, second investment, gives 91 × 4 = £364 income.
Gain by investing £91 × 119 in second stock is £7.
Gain by investing £10000 = £$\frac{10000 \times 7}{91 \times 119}$.

B. I sell out £10000 stock in 3 % at 97, and reinvest in $3\frac{1}{2}$ at 104. What is my change in income?

Product = 97·104.
Income from £97·104 in first is 104 × 3 = £312.
Income from £104·97 in second is 97 × $3\frac{1}{2}$ = £339·10.
Gain in income from 104 shares in first stock is £27·10.
Gain in income from 100 shares in first stock is £$\frac{27 \cdot 10 \times 100}{104}$.

These are but a few examples of the cases where time is saved by taking the multiple of the two quantities given. No doubt the student will be able to apply the principle in many other ways.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

NEW SCHOLARSHIP COURSE FOR 1903.

Second Month—February.

Work for the Month.

1. *Reading.*—Steady oral practice essential. Special preparation. *The Heroes.* Story II. The Argonauts, Parts 1–4. As indicated last month, the hardworking, earnest student will find plenty of time to read many more books than the two indicated for detailed study. There is always a great danger, when preparing for a special examination, to let it assume undue proportions, and exclude from the mind all other ideas than those comprised within the syllabus, with the result that the mental outlook is narrowed, and the whole habit of thought is dwarfed and limited. There is no greater relief and enjoyment after an evening's hard study than to turn to the pages of a standard writer and lose one's self in the thoughts of others, and follow them in their wanderings by sea and by land, or along the more difficult path of serious thought on the many problems of life. This is pleasure rather than work, and will do something to counteract the tendency of young students, and especially teachers, to acquire an undue and exaggerated opinion of their own knowledge and importance.

Now what should a pupil teacher read? It is impossible to lay down any definite list of prescribed or essential books; rather let Ruskin's advice be followed, and everything that attracts be read, with the reservations (1) that the work be that of a recognised author, and (2) that it has attained some reputation. Emerson lays it down as a rule that no book should be read that has not lived, at least, two years, with a steadily increasing reputation. This is good for pupil teachers, although, of course, no book could live for two years with a steadily increasing reputation if the rule were universally followed. The tendency of the age is to read in scraps to the neglect of steady reading; the length of a story is too frequently made to fit the length of the morning or evening railway journey.

No country possesses a grander literature than ours. Supposing it were possible to arrange for Shakespeare, Bunyan, Addison, Defoe, Pope, Spenser, Cowper, Scott, Byron, Wordsworth, Tennyson, Dickens (to mention but a few), to be present at a public meeting, would not thousands and thousands rush to gain admittance at any price; and yet these authors could not say what they have already said to the world—the ideas which may be obtained by every one for a few pence.

One other word of serious warning. If you commence a book which has sold by millions in all parts of the earth, be very chary of pronouncing it "dry." If it contains nothing which interests *you*, it is a sure sign, not that the author is at fault, but that *your* mind is too feeble and weak to appreciate what millions have acclaimed. You cannot expect all at once to read the world's masterpieces and understand them; but instead of stopping all effort, it should spur you on to renewed application. The end is sure: after having served a period of humble service, you will be admitted to the inner shrine.

I mentioned last month a few historical novels which you should read. Of these there are hundreds. Any books of travel, geographical exploration and discovery, biographies of eminent men, popular science, will amply repay the time spent with them. There are a few books which I would specially recommend. Lamb's *Essays of Elia*; Addison's papers in *The Spectator*; Ruskin's *Fronder Agrestes* and *Sesame and Lilies*; Emerson's *Essays*; Hazlitt's *Essays on Poetry*; Carlyle's *Heroes* and *The French Revolution*; Kingsley's *Hypatia*; Macaulay's essays on Clive, Pitt, Hastings, Frederick the Great, and Milton, and *The Lays of Ancient Rome*; Scott's *Ivanhoe*, *Kenilworth*, *Old Mortality*, *Abbot*, *Monastery*, etc.; Dickens's *Pickwick Papers* and *David Copperfield*. Any of the poets, but especially Scott, Longfellow, Tennyson, and Keats. Morris's *Epic of Hades*; Arnold's *Light of Asia*. A student who becomes fairly familiar with the contents of these books will have learned much.

2. *Teaching.*—Chap. ii., *Scholarship School Management.* Methods of teaching.

The elementary principles of psychology in Chap. II. should be thoroughly understood. They underlie all successful teaching. Chap. I. also requires careful thought. What is said of inductive teaching and questioning is especially important.

3. *Drawing.*—One or two copies each week. Send them up for criticism. This will be of more use than general remarks in these columns.

4. *Music.*—Names of chromatic intervals. Relative pitch of keys and notes.

5. *Penmanship.*—Ten minutes' practice per day in the *Practical Teacher Copy Book*, and continual care always.

6. *Composition.*—Write one or two essays each week on such subjects as—

(*a*) Any memorable place you have visited.
(*b*) The use of pictures in teaching.
(*c*) Colonisation.
(*d*) The uses of the electric telegraph.
(*e*) Emigration.
(*f*) Fruit trees.
(*g*) The great Durbar at Delhi.

Read up the subject, if necessary, before attempting to write on it. Prepare a skeleton outline, the heads being arranged in logical sequence. The last subject is an important one historically. There are comparatively few Englishmen who appreciate at all what India really is, and that Lord George Curzon rules more or less directly one out of every five men on this earth.

7. *English.*—(1.) Learn twenty-five roots and meanings each week.

(2.) Prepare thoroughly the grammar and syntax of the adjective, noting particularly the classification, comparison, irregular comparatives, adjectives that do not admit of comparison, and the reasons.

(3.) *The Task*, Book V., lines 41–84. Full notes on this have already appeared in these columns, but any student may have difficulties explained by writing.

(4.) *As You Like It*, Act I., Scene ii.

(Since last month's paper I have received from Messrs. Ralph Holland and Co. *Helps to the Study of "As You Like It,"* by A. L. Cann, which is in all respects an excellent edition.)

Notes.

SCENE I.—The subject is omitted in the opening lines. Shakespeare probably wrote, "My father bequeathed," etc. It must be remembered that these difficult passages are generally the result of the plays being copied in manuscript by different actors, and that the author had not the opportunity of correcting the proofs before the plays were printed.

He stays me at home. An example of the usually intransitive verb being used in a transitive sense.

Be naught awhile. An expletive, the meaning of which is not clear. Probably equivalent to, "Be hanged to you."

Allows you my better = admits that you are my better.

Your coming before me is nearer to his reverence = the fact that you were born before me entitles you to extra consideration from him.

Villein, one of low birth, not necessarily an evildoer. It is a word which has degenerated in meaning. It originally denominated one who dwelt on a *villa*, a farm-house.

You are too young in this. Oliver seizes Orlando, whereupon Orlando grips him with the power that his training in wrestling had brought him, and remarks that his brother is too inexperienced in the art.

To grow upon me = to become so independent that I cannot restrain you.

Here at the door. The scene is described as in an orchard. Here it appears to be in a house. The student must remember that this transformation was easy in Shakespeare's time, when appropriate scenery was unknown. The bare boards, with perhaps a sign, "This is an orchard," constituted all the *mise en scène*.

Died to stay—that is, died of grief if she had stayed.

A many. This is a Shakespearian idiom—the use of *a* before many—similar to our use of "a dozen," "a score," etc.

The golden world, the Golden Age of the mythologists, before sin, disease, and care invaded the earth, and when the inhabitants of the world lived in pastoral simplicity and joy.

Marry. An expletive = by the Virgin Mary. So also Zounds! = by God's wounds; 'Strewth! (slang) = by God's truth; by Gad! = by God.

I am given to understand. "To understand" is in this case an infinitive residual object of *am given* (see grammar).

I had as lief = I would as willingly.

Thou wert best look to't = it (that is, to look to it) would be the best thing for thee. *Thou* was originally *for thee*, the Anglo-Saxon dative; but from its position it assumed the form of the nominative.

Hates nothing more than he. He grammatically should be *him*.

Scene II.—The character of Rosalind deserves special study. She is the brightest, wittiest, most lovable character in all the Shakespearian gallery of women. Other characters may surpass her in individual points, but collectively she is far beyond them all. Even in boy's attire she loses none of that true womanliness which is her chief charm.

Hath no child but I. Grammatically should be *but me*.

Touchstone. The old saying, "It takes a wise man to be a fool" is nowhere better exemplified than in the plays. Shakespeare's fools have a keen wit, a biting tongue, and a ready humour that make them delightful companions. The fool in *King Lear*, Feste in *Twelfth Night*, and Touchstone in *As You Like It* form an admirable trio.

Nature's natural, an idiot or fool. A peculiar use of the word, originally used as implying that a person had no more knowledge than nature had endowed him with at birth.

The best is yet to do—that is, *to be done.* The active form is used with a passive sense. Compare, "house to let," "bread to eat," etc.

If I had a thunderbolt in mine eye, I can tell who should down = If I had the power of discharging a thunderbolt by my looks, I know which I would strike down.

The duke is humorous—that is, fickle, changeable in disposition, easily put in a fit of anger.

(5.) The Norman Conquest, and the changes in the language it produced. This is the most important period in the history of the language. The highly-inflected Anglo-Saxon, with a comparatively small vocabulary, lost the greater part of its inflections and gained an enormous number of new words from the Norman-French, which in its turn came from the Latin. As the character of the people was improved by the Norman-French strain, so the language increased in power. The chief changes may be summarised thus:—

The Anglo-Saxon lost—

(1.) The power of forming compounds—for example, *bidding-sale* became *auction; gold-hoard, treasure; earth-tilth, agriculture*, etc. Many beautiful and very expressive compounds were lost.

(2.) The majority of inflections. This is easily understood. The foreigner picking up the language by ear remembered the stem, but did not trouble about the particular ending to denote case, etc.

It gained (1) many new words relating to feudalism, legal proceedings, the chase, the church. New ideas demand new words; and as the Normans were more highly educated, they had many ideas which were unknown to the Anglo-Saxons, and hence new words had to be introduced. This is always going on. A new invention or discovery generally means a new word added to the language.

(2.) Class words. Thus, *father, mother, son, daughter* are Anglo-Saxon—*relation* is Norman; *dig, plough, sow, reap* are Anglo-Saxon—*agriculture* is Norman; *run, jump, fly* are Anglo-Saxon—*action* is Norman, etc.

(3.) Bilingualism—that is, two words for the same thing—*act* and *deed, will* and *testament.* Doublets—that is, two words from the same root with different meanings. Hence we obtain shades of expression—*childish* and *puerile* are not the same thing.

The rules by which words of Anglo-Saxon origin may be recognised are given fully in *The Pupil-Teacher's Notebook*, and these should be carefully learnt.

8. *Geography.*—(1.) India. Physical features, climate, productions, imports, exports.

(2.) Europe. Revise Holland and Belgium, Germany, Scandinavia.

Notes.—India requires very careful study. The text-book will supply the chief facts; an exact map must be drawn and committed to memory. The importance of the monsoons must be clearly understood. From November to May, the sun being vertical over the great land-mass of Africa and not so over Asia, the air above the former becomes heated, and a general current of cooler air from Asia sweeps across the Indian Ocean. This is the north-east monsoon. In the spring, Africa is losing heat and Asia is gaining, till in May both are at the same temperature; the monsoon dies away, and for about a month the vertical sun pours its heat over India, with no breeze to mitigate its fierceness. This is the period of heat. The whole country assumes a dull brown appearance, insect life largely disappears, wild animals wander into the villages in search of water, and Europeans fly from the baking plains to the cooler sanatoria on the hills. Gradually the south-west monsoon sets in. Heavy clouds sweep up over the Indian Ocean, till the monsoon breaks with tremendous thunderstorms and a deluge of rain. Upon these "rains" depend the harvests and prosperity of India for the ensuing year. The country rapidly assumes a green tint, seeds are sown, and, under the teeming heat, grow with a rapidity we can hardly realise.

As India is mainly an agricultural country, the supply of water is most important. A deficiency in the rains means a bad harvest, and that in its turn a famine. It is to prevent the possibility of the latter that the Government have spent enormous sums in constructing tanks, canals, and irrigation works. The presence of good roads and railways also enables the authorities to pour supplies into a famine-stricken district, a thing impossible when the only means of transit was the bullock-cart.

Note also the importance of the forests, which are carefully tended by the Government. During the forty-six years that the British Government has been responsible for India, much has been done to develop agriculture by irrigation works, railways, improved methods, etc., with the result that India to-day is in a more prosperous state than it has ever been. Still the country is *poor*, very poor, and not the land of gold and precious stones which it was once popularly supposed to be.

Imports and exports for 1901–2 in order of value:—

Imports.—Cotton goods and yarn (£22,000,000), metals (£4,600,000), sugar (£3,900,000), mineral oil (£2,558,000), machinery, provisions, woollen goods, hardware and cutlery, apparel, liquors, railway plant, silk, precious stones, drugs, glass, spices, salt, dyes, and chemicals.

Exports.—Seeds (£11,186,000), raw cotton (£10,000,000), rice (£9,000,000), jute (raw) (£7,800,000), cotton yarns and cloths (£7,000,000), jute (manufactured), opium, hides and skins, tea, wheat and flour, indigo, coffee, wool, lac, silk, spices, fodder, teak, oils, coal, manures.

The following Government questions will help to test reading:—

(1.) Describe two of the great mountain ranges of India, and name the rivers which rise in or break through them.

(2.) Describe a coasting voyage from Calcutta to Bombay.

(3.) Say what you know of the causes, effects, and times of the monsoons in northern and southern Hindustan respectively.

(4.) What are the chief exports of India? What goods does it take from us?

(5.) Explain by reference to the climate of the country why it is desirable for Europeans to spend a portion of the year in one of the hill stations of India.

(6.) "Many rivers of India rise in the Western Ghâts and flow eastward." Show that this statement is correct, and give reasons for the fact.

(7.) Into what three portions does the peninsula of India physically divide itself? State very briefly some physical characteristics of each portion.

9. *History.*—The Normans, 1066–1154.

Chief points.—William the First.

(1.) The perfection of the Feudal System. Note the differences between English and Continental feudalism. William distributed the lands which he assigned to his great barons, and by the Salisbury Decree, 1086, made all men swear allegiance to him.

(2.) The results of the Conquest on the constitution, church, relations with the Continent, law, race, social life, art, language, etc.

William the Second.—(1.) Flambard and his oppressions.

(2.) The Investiture Dispute.

(3.) The Crusades: causes, events, results.

Causes.—(*a*) The religious and chivalrous spirit of the age.

(*b*) The influence of the church, which gained by them in wealth and power.

(*c*) The desire to extend commerce.

(*d*) The fall of Jerusalem (1076).
(*e*) The preaching of Peter the Hermit.
Henry the First.—(1.) The Great Charter.
(2.) Invasion of Normandy.
Stephen.—(1.) The Civil War and its attendant miseries. Battle of the Standard.
(2.) Treaty of Wallingford.

10. *Arithmetic.*—Revise vulgar and decimal fractions, and work Nos. 51-100 in Christian and Collar. Pay especial attention to the theory part of fractions, the turning of vulgar fractions to decimals and *vice versâ*, and the laws governing recurring decimals.

11. *Algebra.*—G.C.M. and L.C.M. Use factors wherever possible. Work the following test paper in factors :—
Find the factors of :—

(1.) $8x^2 - 38xy + 35y^2$.
(2.) $160 - 27x^3 - x^6$.
(3.) $9x^6 - 12x^3y^3 + 4y^6$.
(4.) $x^3 - y^3 - z^3 - 3xyz$.
(5.) $x^2 - 6y^2 - 3z^2 + 11yz + 2zx + xy$.
(6.) $2a^2 - 6b^2 - 4c^2 + 11bc + 2ca + ab$.
(7.) $a^2 - 4ab + 4b^2 - a + 2b - 12$.
(8.) $(a + b)^2 + (a + c)^2 - (b + a)^2 - (c + d)^2$.
(9.) $4(ab + cd)^2 - (a^2 + b^2 - c^2 - d^2)^2$.
(10.) $x^3 - 1 + 6xy + 8y^3$.

(Work without reference to answers, which will be found at end of course.)

12. *Euclid.*—Revise 11-20, Book I., with six deductions per week.

13. *Elementary Science.*—The mechanical powers. Lever, pulley, inclined plane, and the screw.

14. *General Information.*—Take one of the books of questions on this subject mentioned last month, and work through a paper a week. If you meet with anything you cannot find out, write for explanation.

Test Paper on General Information.

The answers to these questions are marked gratis. They should be written on foolscap, one side only, the coupon of the current number must be enclosed, and a stamped addressed envelope for return.

All papers should be sent to Mr. A. T. Flux, The Bays, Belvedere, Kent.

A prize of One Guinea will be given to the student securing the highest percentage of marks through the course.

1. Give briefly the principles of wireless telegraphy.
2. Give the meaning of the following abbreviations, etc. :—*Ad hoc*, *verb. sap.*, *nem. con.*, *ad lib.*, *mem.*, *pro and con.*
3. What do the following stand for?—P. & O., C.T.C., I.O.U., P.P.C., R.A., M.R.C.P., 8vo.
4. What are the commonest impurities of water?
5. Distinguish between the meanings of the following :—*Stationary* and *stationery*; *ascent* and *assent*; *baton* and *batten*; *counsellor* and *councillor*; *farther* and *further*; *later* and *latter*; *warp* and *woof*.
6. Write down ten important books in English. Mention the author of each, and say approximately when he lived.
7. What are immediate and deferred annuities?
8. Where are the White House, the Parthenon, the Escurial, the Golden Horn, the Vatican, the Pillars of Hercules, the Coliseum?

Questions on Last Month's Work.

1. *Penmanship.*—Large Hand.—*Northumberland.*
Small Hand.—*I heard a thousand blended notes*
While in a grove I sat reclined.
2. How can the memory be developed?
3. Write an essay on the new Education Act.
4. Analyse the following, and parse words in italics :—
Smooth as a wall the upright remnant stands;
With *such* undeviating and even force
He severs it away: no needless *care*
Lest storms *should overset* the leaning pile,
Deciduous, or its *own* unbalanced weight.
5. Give in your own words Orlando's cause of complaint against his brother.
6. Say what you can of the manufactures of Spain and Portugal.
7. Point out the importance of Gibraltar, Aden, Singapore, and Hong-Kong as British possessions.
8. Trace the growth of Wessex. By what victories did it establish its supremacy?
9. What do you know of Dunstan and his aims? How far was he successful in carrying them out?
10. Explain clearly, and give proofs of, the indestructibility of matter.

Answers to paper in factors—

1. $(4x - 5y)(2x - 7y)$.
2. $(32 + x^5)(5 - x^5)$.
3. $(3x^2 - 2y^3)(3x^2 - 2y^3)$.
4. $(x - y - z)(x^2 + y^2 + z^2 + xy + xz - yz)$.
5. $(x + 3y - z)(x - 2y + 3z)$.
6. $(2a - 3b + 4c)(a + 2b - c)$.
7. $(a - 2b - 4)(a - 2b + 3)$.
8. $2(a - d)(a + b + c + d)$.
9. $(a + b + c - d)(a + b - c + d)(a - b + c + d)$
$(-a + b + c + d)$.
10. $(x + 2y - 1)(x^2 + 4y^2 + 1 - 2xy + x + 2y)$.

PUPIL TEACHERS' COURSE.

For Candidates' Examination, 1903.

1. *Reading and Repetition.*—Continue regular oral practice. Read to understand; do not let any phrase or passage go by without thoroughly appreciating it. Mere repetition of words is a very small part of reading.

2. *English.*—Prepare ver. 1 and 2 of the *Ode on Spring.*

General meaning :—"Venus, the goddess of Spring, now approaches, accompanied by her attendants, the Hours, their bosoms laden with roses and other flowers. The flowers, who have long been awaiting her arrival, now burst forth into bloom, and make the season bright with their colours. The nightingale pours forth her song, and is answered by the cry of the cuckoo, the voices of the birds forming a beautiful harmony. The soft winds pass under the clear blue sky, scattering the perfumes they have gathered from a thousand flowers."

VERSE 1.—*Lo* may be taken as a verb = *look*, governing the noun sentence following rosy-bosomed—that is, bosoms laden with bright-coloured flowers.

The Hours were the goddesses of the various seasons of the year.

Venus. The month of April was sacred to Venus. Gray seems to have been rather undecided as to the title of the poem. He originally called it *Noontide*, which is perhaps more appropriate, for the general idea is rather that of a warm summer day than a spring day. The song of the nightingale, the thick branches of the oak, and the vigour of the insect life belong rather to summer than to spring.

Purple. The Latin *purpureus* was used for many bright colours, and was not restricted in meaning as it is now.

Attic warbler. The nightingale, which is very common in Attica (Greece).

Harmony is in apposition to the idea in the two preceding lines.

Whispering. Participle qualifying *zephyrs*, and governing *pleasure.*

VERSE 2.—"In the cool shade of the wide-spreading branches of the oak, or where the beech with its moss-covered trunk and branches affords a protection from the sun, by the side of the rippling brook, I will lay myself down, and, helped by the muse of poetry, will think how useless is the perpetual toil of mankind, how insignificant are those who are puffed up with pride, and upon how very little rest the claims of those who are considered great."

The first two sentences are adverbial to *shall sit.*

Some. Indefinite demonstrative adjective.

The muse. The goddess of poetry, who inspired him with poetical ideas.

At ease reclined, etc. This line is best taken as an enlargement of *me.*

Proud and *great* are nouns.

Revise all suffixes thoroughly.

3. *History.*—George the First, George the Second, George the Third.

Read carefully all your text-book says, and note particularly the Rebellion of 1715, the Septennial Act, the South Sea Bubble, life of Walpole and his administration, the War of the Austrian Succession, the Seven Years' War (this is very important), the loss of the American colonies (note the causes carefully), the war with France—Nelson, Wellington, Moore, etc. The battles of the Nile, Copenhagen, Waterloo should have special attention. You should also note the great revolution in the industries. It was during the second half of the eighteenth century that England began its career as a great manufacturing nation.

4. *Geography.*—Finish Ireland.

The following questions have been asked :—

(1.) Describe a journey from Chester to Belfast *viâ* Dublin, noticing anything of interest *en route*.

(2.) Name the chief ports of Ireland, with notes on their manufactures and trade.

(3.) What peculiarities distinguish Ulster from the rest of Ireland, and how do you account for them ?

(4.) York, Valentia, Dungeness, Sumburgh Head, Malin Head, Stornoway, Ardrossàn, and Belmullet—all these are mentioned in the weather reports. Describe their positions.

(5.) Say what you can of the railways of Ireland.

(6.) What parts of Ireland produce butter, cheese, linen, flax, oats, and pigs ?

(7.) Why is Ireland called the Emerald Isle ?

5. *Arithmetic.*—Continued exercise in proportion, with general examples on the year's work.

6. *Euclid.*—Props. 27–32, with two deductions per week.

7. *Algebra.*—Elementary fractions.

8. *Elementary Science.*—Revise as far as possible. Next month a collection of questions for revision will be given.

Test Questions.

1. *Penmanship.*

Large hand—*Great Britain.*

Small hand—*Lo ! where the rosy-bosom'd Hours,*
Fair Venus' train, appear.

2. Write a short essay on Books.

3. Give the meanings of the suffixes or inflections in the following words—*growth, whom, rivulet, highest, sparkle, bounteous, orator, braggart, spinster, fantastic.*

4. Describe the Great Plague or the Great Fire.

5. What changes did the Revolution of 1689 bring about in England ?

6. Draw a sketch-map of Ireland, marking the rivers and mountains.

7. Work the following :—

(1.) Determine the prime factors of 40380 and 5757, and hence deduce the G.C.M. and L.C.M. Ans. 3 ; 77498220.

(2.) Thirty-three telegraph posts placed at equal distances extend a mile. How far apart are the posts ? Ans. 55 yds.

(3.) Find a fraction which shall bear the same ratio to $\frac{2}{3}$ that $\frac{3}{5}$ does to $\frac{4}{5}$, and a number which shall bear the same ratio to 100 that 44 does to 1760. Ans. $\frac{9}{10}$; $2\frac{1}{2}$.

(4.) Simplify—

(i.) $\dfrac{4\frac{1}{2} + 7\frac{3}{5}}{13\frac{1}{4} - 9\frac{3}{4}} \times 1\frac{1}{20}\frac{6}{5} \div \dfrac{2\frac{1}{2} + 3\frac{3}{5}}{8\frac{1}{2} - 1\frac{3}{10}}$

(ii.) $\dfrac{3\frac{3}{5}}{4\frac{1}{2}} - \dfrac{3\frac{1}{2} - \frac{4}{5}}{3\frac{1}{2} + \frac{4}{5}} + 12\frac{7}{15}$. Ans. $5\frac{1}{2}\frac{2}{5}$; $12\frac{7}{15}$.

(5.) A garrison of 2500 men is provisioned for 96 days. After 14 days, 450 men leave. How long will the provisions last the men who remain ? Ans. 100 days.

8. Describe the construction of an air-pump. For what scientific purpose can it be used ?

9. (*a*) What circumstances modify the mental effects of scale tones ?

(*b*) Name the intervals—

r—t, t_1—s, r—l, f—t, m—d^1, t_1—f, r—f.

(*c*) State the major scale relations (subdominant, etc.) of—

s, d^1, f, r, t.

First and Second Years.

1. *Reading and Repetition.*—As much oral practice as possible. See note in Scholarship Course on reading.

2. *English : First Year.*—Cowper's *Task*, Book V., lines 305–335, or Cowper's *Expostulation*, lines 304–339.

Second Year.—Milton's *Paradise Lost*, Book III., lines 523–587.

Second-year students must not lose sight of the additional work prescribed, namely—"Elementary History of the English Language," and "Common Errors in the Language—Written and Spoken." Both of these points are treated at sufficient length in the *Pupil-Teacher's Notebook.*

Special Study.—(*a*) The conjunction. (*b*) Palgrave's *Golden Treasury*, No. 145, "Il Penseroso." Study this in connection with the preceding, and note the points of contrast.

3. *History : Revise the Year's Work.*—Pupil teachers should endeavour to arrange for their year's work to commence in January, so that they can have a full year's work at the Scholarship Syllabus. With this idea, we shall arrange to get through the second year's work by Christmas next. In addition to the revision, prepare the reigns of James the First and Charles the First as far as the outbreak of the Civil War.

Second Year.—As in Scholarship.

The following questions will help in revision :—

(1.) Enumerate the chief rebellions of the barons against the first five kings after the Norman Conquest. At what objects did the rebels usually aim ?

(2.) What was the influence on the political and social life of England of the Crusades or the Hundred Years' War ?

(3.) Write a life, with dates, of any one of the following :—Anselm, Neville, Wolsey, Simon de Montfort.

(4.) What were the chief changes introduced into England by the Norman Conquest ?

(5.) Who were Elizabeth's chief advisers, and what general line of foreign policy did they recommend ?

(6.) Give an account of the relations between England and Scotland in the time of Edward the First.

(7.) What changes in the political and social state of England may be traced to the visitation of the Black Death ?

(8.) What do you understand by the Feudal System ? How far is it correct to say it was introduced by William the First ?

(9.) In what ways did William the First, Edward the Third, and Richard the Second attempt to limit the authority of the Popes in England ?

(10.) What do you know of the Assize of Clarendon, Provisions of Oxford, *Canterbury Tales*, Grosseteste, Sir John Oldcastle, Protector Bedford, Sir Philip Sidney ?

(11.) On what grounds were Edward the Second, Richard the Second, and Henry the Sixth deposed ?

(12.) Give an account of the Reformation in the reign of Edward the Sixth.

(13.) How do you account for the loss of the French possessions in the reign of Henry the Sixth ?

(14.) In what way did Edward the First add to the greatness of England ?

(15.) What do you know of Domesday Book, Evesham, Flodden, Calais, Black Death, Star Chamber ?

(16.) What do you know of the Lollards, Pilgrimage of Grace, Lords Ordainers, High Commission Court, Crusades, Peasants' Revolt ?

(17.) What troubles did William the Second and Henry the First meet with from (*a*) the barons, (*b*) the clergy ?

(18.) What do you know of the Barons' War, Wallace, Constitution of Clarendon, Battle of Poitiers, Act of Supremacy, Ket ?

(19.) What is Parliament ? What stages in its growth do you connect with Simon de Montfort, Edward the First, Henry the Fourth ?

(20.) What was the claim of Mary Queen of Scots to the throne ? Why did the Scotch rebel against her ? and why did Elizabeth put her to death ?

4. *Geography : First Year.*—Finish Asia, and prepare answers to the following questions :—

Government Questions on Asia.

(1.) What do you know of the trade, government, and political importance of Afghanistan ?

(2.) Give some account of Chitral, Formosa, Fuji-san, Armenia, the Terai, Amur.

(3.) Write a few lines about four of the following :—The Brahmaputra, Calcutta, Cawnpore, Jumna, Kashmir, Nepal.

(4.) What do you know of the Caspian Sea and its shores ?

(5.) Write an account of the Siberian Railway.

(6.) Give a short account of Japan or Siberia.

(7.) A traveller goes from Calcutta to Teheran. Describe his journey, stating what countries he would traverse, what towns he would visit, his modes of locomotion, and the manners and customs of the natives in the countries traversed.

(8.) Give a full account of the Persian Empire, the states by which it is bounded, and the chief industries and religions of its people.

(9.) Say what you know of the Indo-Chinese peninsula, especially of the Straits Settlements.

(10.) Where and what are Hoangho, Amoy, Korea, Samarcand, Manipur, Everest, Persepolis, Doab ?

(11.) Where and what are Tomsk, Damascus, Jaffa, Tonkin, Teheran, Kandahar ?

(12.) State the exact position and say what you know of the Tundras, Vladivostok, Goa, Kandy, Darjeeling, Aleppo, Yemen, Khelat.

(13.) Write a few lines about four of the following :—Kurrachee, Philippine Islands, Cabul, Rangoon, Manchuria, Sea of Aral.

(14.) Show that the geography of Central Asia would furnish good illustrations for a lesson on climate.

Second Year.—As in Scholarship.

5. *Arithmetic: First Year.*—Discount and compound interest. Make quite sure of the difference between true and banker's discount. This is practically the only difficulty in the subject.

In compound interest, work out the interest for each year, and add—

For example, to find the compound interest on £1200 for 3 years at 4 per cent.—

$4\ \% = \frac{1}{25}$ (so $5\ \% = \frac{1}{20}$; $3\ \% = \frac{1}{33\frac{1}{3}}$, etc.)

Principal	=	1200
First year's interest = $\frac{1}{25}$	=	48
Second year's principal	=	1248
Second year's interest = $\frac{1}{25}$ of this	=	49·92
Third year's principal	=	1297·92
Third year's interest = $\frac{1}{25}$ of this	=	51·9168
Amount at end of 3 years	=	1349·8368
Deduct principal		1200
Interest	=	149·8368
		20
		16·7360
		12
		8·8320

Ans. £149, 16s. 8·832d.

Use this as a model solution. Work in decimals of £1, and not in shillings and pence.

6. *Euclid: First Year.*—Props. 41–44, with two deductions each week.

Second Year.—Book III., Props. 7–12; and in addition, revise as set out in the Scholarship Course.

7. *Algebra: First Year.*—Chap. XIII., Hall and Knight. Simultaneous Equations.

Second Year.—As in Scholarship.

8. *Elementary Science.*—A collection of questions will be given next month. Meanwhile revise any weak point.

Test Questions.

FIRST YEAR.

1. Give in your own words Cowper's ideas as to the origin of kings, or write a short essay on the state of England at the time the *Expostulation* was written.

2. Write out a classification of adverbs, giving examples of each class.

3. Give the derivation of the following words (prefix, root, affix)—*irreducible, projection, interruption, expostulation, conjunction, illimitable, pellucid, synthetic, analysis.*

4. How do you account for the social distress in England in the reigns of Henry the Eighth, Edward, and Mary? What popular risings took place?

5. In what respects did England advance during the reign of Elizabeth, and to what causes do you attribute the advance?

6. Say what you can of Afghanistan. Illustrate your answer by a sketch-map. What is its importance politically?

7. Say what you can of the Dutch possessions in the East Indies.

8. Work the following test paper:—

(1.) (*a*) Define a decimal fraction.

(*b*) How can you tell whether a vulgar fraction can be converted into a finite decimal?

(*c*) A boy was reducing $\frac{1}{7}$ to a decimal. He had worked it out to 18 places without its recurring. How would you prove to him that he was wrong?

(*d*) What is the difference between $\cdot 3\dot{5}71428\dot{5}$ of 5s. 10d. and $\cdot 6\dot{1}2857\dot{1}$ of 2s. 11d.? Ans. $2\frac{1}{2}$d.

(2.) Find the difference between

£2, 17s. 6d. and 2 cwt. 2 qrs. 10 lbs.

£12, 18s. 9d. and 12 cwt. 0 qr. 19 lbs. Ans. $\frac{4}{423}$.

(3.) A man pays away half his money to A, one-third of what he has left to B, and one-fifth of what he has still left to C. If, after these payments, he has 12s. 8d. left, how much had he at first? Ans. £2, 7s. 6d.

(4.) Divide £3, 18s. 4d. among three persons, A, B, C, so that B may receive seven-eighths as much as A, and C 5s. more than B. Ans. A, £1, 6s. 8d.; B, £1, 3s. 4d.; C, £1, 8s. 4d.

(5.) Find by practice the value of 2 lbs. 7 oz. 15 dwt. 20 grs. of gold at £46, 14s. 6d. per lb. Ans. £123, 15s. $9\frac{5}{9}$d.

SECOND YEAR.

1. Give in your own words Milton's ideas on predestination.

2. What changes occurred in the English language between 1485 and 1603?

3. Correct the following (if necessary), and give your reasons.

(*a*) "O thou, my voice inspire
Who touched Isaiah's hallowed lips with fire."

(*b*) Of all men else have I avoided thee.

(*c*) In reading, you should sit as uprightly as possible.

(*d*) The four first kings after the Conquest were Normans.

(*e*) His younger days were spent in England, waiting for an opportunity to get to France.

(*f*) Profusion, as well as parsimony, are to be avoided.

4. Work the following test paper:—

(1.) Find the cost of carpeting a room 12 ft. 4 in. broad by 12 ft. 6 in. long with carpet $\frac{3}{4}$ yd. wide at 4s. 6d. per yd.
Ans. £5, 2s. $9\frac{1}{2}$d.

(2.) Find the compound interest on £254 in 3 years 5 months at 3 per cent. Ans. £27, 0s. 5·295894d.

(3.) The difference between true and banker's discount on a bill due 12 months hence is £15. Find the amount of the bill, interest being calculated at 5 per cent. per annum.
Ans. £6300.

(4.) If 17 lbs. of tea worth 4s. per lb. is mixed with 25 lbs. worth 4s. 8d. per lb., and the whole is sold at 5s. 4d. per lb., what is the total gain, and what the profit per cent.?
Ans. £1019, 4s.; $21\frac{83}{277}$.

(5.) Express $\sqrt{1\cdot\dot{5}^2 7} \times 1\cdot\dot{5}7142\dot{8}$ as a vulgar fraction in its lowest terms. Ans. $1\frac{828427}{999999}$.

5. Mention any legislation of the nineteenth century which has improved the social condition of the working classes.

CORRESPONDENCE: RULES.

To ensure an answer in the next issue, queries must be sent by the 15th of each month.

Name and address of sender, with coupon of current number of THE PRACTICAL TEACHER (and *nom de plume* if desired), must be enclosed.

As a rule, all replies will appear in the Correspondence Column; but any one desiring an immediate reply may obtain it by enclosing a stamped addressed envelope.

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to "Mr. A. T. FLUX, The Bays, Belvedere, Kent."

LOGIC FOR L.L.A. AND LONDON MATRICULATION.

BY T. E. MARGERISON, M.A. (LOND.),
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VII.

Figure and Mood.—Having considered the structure and fundamental rules of the syllogism, we now pass on to the various forms in which it is found. These depend on two factors: (1) the position of the terms in the premises; (2) the quantity and quality of the premises and the conclusion, producing respectively the different *figures* and *moods* of the syllogism.

The *figure* of a syllogism is its form as determined by the position of the terms in the premises. Denoting the major, middle, and minor terms by the letters P, M, S respectively, we have four possible arrangements forming the four figures of the syllogism, as shown in the following table:—

I.	II.	III.	IV.
M — P	P — M	M — P	P — M
S — M	S — M	M — S	M — S
S — P	S — P	S — P	S — P

The conclusion remains invariable in all the forms. The key to the figures is the position of the middle term in each of the premises; this must be carefully noted.

Special Rules of the Figures.—By considering each figure, and applying to it the general rules of the syllogism, we obtain special rules applicable to each figure. Taking the figures in order, the rules are as follows:—

Figure I.—(1.) *Major premise must be universal.* For if it is particular, the minor premise must be negative in order to distribute the middle term (Rule 3). Then the conclusion must be negative (Rule 6), and the major term, being its predicate, will be distributed; therefore major term must also be distributed in major premise (Rule 4), and therefore major premise must be negative—that is, both premises are negative, which

is impossible (Rule 5). Hence the major premise cannot be particular.

(2.) *Minor premise must be affirmative*, because, if negative, the conclusion must be negative (Rule 6), and major premise must also be negative to prevent illicit process of the major term. Hence both premises are negative, which is impossible.

Figure II.—Consider the figure as given above, and we have—(1.) *Major premise must be universal*, because, if particular, the major term is undistributed, therefore conclusion must be affirmative to prevent illicit process of the major term; therefore minor premise must be affirmative (Rule 6). But the middle term, being in each premise the predicate of an affirmative proposition, is undistributed, which is impossible (Rule 3).

(2.) *One premise must be negative* (Rule 3).

Figure III.—(1.) *The minor premise must be affirmative*, because otherwise the conclusion would be negative, and the major term distributed in conclusion; therefore major premise must be negative to prevent illicit process—that is, both premises would be negative.

(2.) *The conclusion must be particular.* For, by previous rule, S is undistributed in the minor premise, therefore it must be undistributed in the conclusion.

Figure IV.—(1.) *If the major premise is affirmative, the minor must be universal*, for otherwise there would result *undistributed middle.*

(2.) *If the minor premise is affirmative, the conclusion must be particular*, to prevent illicit process of the minor.

(3.) *If either premise is negative, the major premise must be universal;* for the conclusion will be negative, and if the major premise be not universal, we get illicit process of the major.

Moods.—By the *mood* of a syllogism is meant its form as determined by the quality and quantity of the premises and the conclusion. For example, **AAA** is a mood in which both the premises and also the conclusion are universal affirmative propositions; **EAO** is a mood in which the major is a universal negative, the minor a universal affirmative, and the conclusion a particular negative.

Taking the four kinds of propositions **A, E, I, O**, we can combine them in threes in sixty-four different ways—thus, **AAA, AAE, AAI, AAO, AEA, AIA,** etc. Examining the syllogistic moods thus obtained, only eleven will stand the test of the rules of the syllogism. By varying the position of the terms in the premises, each of these eleven moods has four different forms, one in each figure; but of the forty-four moods thus resulting, only twenty-four are valid, and of these, five, known as the *weakened* or *subaltern moods*, are of no value, because in each the conclusion is particular when a general conclusion might have been drawn. We have then remaining *nineteen* valid and useful moods. These are best remembered by the famous mnemonic lines:—

*Barbara, Celarent, Darii, Ferio*que prioris;
Cesare, Camestres, Festino, Baroco, secundæ:
Tertia, *Darapti, Disamis, Datisi, Felapton,*
Bocardo, Ferison, habet: Quarta insuper addit
Bramantip, Camenes, Dimaris, Fesapo, Fresison.

The words in italics are artificial forms each representing a mood; the vowels of each word show the propositions composing the mood—thus, *Barbara* indicates **AAA**, *Felapton* **EAO.** The fuller significance of the mnemonic words is dealt with below. The words in ordinary type are Latin words indicating to what figures the syllogisms represented by the artificial words belong.

Reduction of Syllogisms.—Reduction is the process whereby the reasoning contained in a given syllogism is expressed in another figure. Reduction is generally to Figure I., because that was regarded as the most perfect figure, for to it alone the *Dictum de omni et nullo* applies directly, and in it the argument is most obviously valid.

The mnemonic lines show how the process of reduction is effected:—

The initial letter in each artificial word marks the syllogism of the First Figure to which a syllogism in one of the other figures will reduce; as, *Camestres* to *Celarent*, *Disamis* to *Darii*, etc.

s denotes simple conversion of the preceding proposition.

p denotes the conversion by limitation (*per accidens*) of the preceding proposition.

m denotes metathesis or transposition of the premises.

c denotes indirect reduction, or *reductio ad impossibile.*

Thus the only meaningless letters are *r, n, t, l,* and *b* and *d* when not initial.

The process is illustrated by the examples below:—

1. *Datisi* reduces to *Darii*—

All Italians are Europeans.
Some Italians are artists.
∴ Some artists are Europeans.

All Italians are Europeans.
Some artists are Italians.
∴ Some artists are Europeans.

s in *Datisi* tells us to convert the preceding proposition, the minor premise.

2. *Camestres* reduces to *Celarent*—

All stars are self-luminous.
No planets are self-luminous.
∴ No planets are stars.

No self-luminous bodies are planets.
All stars are self-luminous.
∴ No stars are planets = (by simple conversion)
No planets are stars.

m denotes that the premises are to be transposed.

s requires conversion (1) of the second premise in the original syllogism, and (2) of the conclusion.

3. *Bramantip* reduces to *Barbara*—

All nouns are names.
All names are words.
∴ Some words are nouns.

All names are words.
All nouns are names.
∴ All nouns are words = (by conversion *per*
Some words are nouns. *accidens*)

m requires metathesis or transposition of the premises, and *p* conversion of the conclusion *per accidens.*

In the above examples we have *direct* or *ostensive* reduction. Reduction is said to be *indirect, per impossibile* or *ad impossibile*, when a new syllogism is formed which establishes the validity of the original conclusion by proving its contradictory to be false. This method is used in the reduction of *Baroco* and *Bocardo.*

Consider the following example of *Baroco*—

All metals are conductors.
Some minerals are not conductors.
∴ Some minerals are not metals.

If the conclusion is false, then its contradictory, "All minerals are metals," must be true. Taking this as a new minor, and combining it with the original major, we get a syllogism in *Barbara*—

All metals are conductors.
All minerals are metals.
∴ All minerals are conductors.

But this conclusion contradicts the original minor premise; and since the latter must be accepted as true, the new conclusion must be false. Therefore, "All minerals are metals" must be false; and hence its contradictory, the original conclusion, "Some minerals are not metals," must be true.

Remarks on the Figures.—It will be noticed that in Figure I. it is possible to prove conclusions of all the forms **A, E, I, O.** Moreover, it is the only figure in which a universal affirmative conclusion can be proved. Figure I. is therefore the most important and useful of all the figures; in it the reasonings of deductive science are commonly expressed.

Figure II. proves negative conclusions only, and is therefore chiefly used to disprove some assertion.

Figure III. proves particulars only, and is therefore employed in objecting to a universal proposition.

The Fourth Figure is of little importance. Its arrangement is unnatural, and the argument can be better expressed in the First Figure. It is therefore seldom used, and some logicians refuse to recognise it.

QUESTIONS.

(Students can have their exercises corrected by sending them to the Editor, Logic Course, PRACTICAL TEACHER, and enclosing seven stamps.)

1. What are the *figures* of the syllogism? Show that **IAI** is an allowable mood in the Third Figure, but in the First it would have an undistributed middle.

2. Prove from the rules of the syllogism that a universal affirmative conclusion is only possible in Figure I.

3. Reduce the following arguments to syllogistic form, and if formally invalid, point out the formal fallacy involved:—

(1.) Some chairs are not comfortable; hence some chairs are not properly made, for whatever is not properly made is not comfortable.

(2.) None but ruminants are cloven-footed; for none but ruminants chew the cud, and all cloven-footed creatures chew the cud.

4. Construct syllogisms to prove and disprove—
"Some laws are mischievous."

5. Show how the following moods violate (1) the general rules of the syllogism, (2) the special rules of the particular figures—**AEE**, in Figure I.; **AAA**, in Figure II.; **AEE**, in Figure III.; **AAA**, in Figure IV.

OUR CERTIFICATE COURSE FOR 1903.

BY GEORGE COLLAR, B.A., B.SC.,

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TEST QUESTIONS ON LAST MONTH'S WORK.

Theory of Teaching.

1. What do you understand by the assertion that arithmetic is a science as well as an art? Illustrate your answer by showing how you would teach proportion (*a*) in a scientific, and (*b*) in a practical way. (Certificate, 1892.)

2. Frame three sets of questions in arithmetic, suited for the examination of scholars in the third, fourth, and fifth standards respectively, so as to test knowledge of the reason for rules as well as of their application to practice. (Certificate, 1892.)

3. Describe any special methods that might be adopted by a teacher in a poor neighbourhood for promoting personal cleanliness among his scholars.

English Literature.

1. Write a summary of the last Act of *Richard III.*

2. Explain the following, and give the context:—

(*a*) "Remember Margaret was a prophetess."
(*b*) "What, is my beaver easier than it was?"
(*c*) "Under their tents I'll play the eavesdropper."
(*d*) "Tell the clock there. Give me a calendar."

English History.

1. What grounds were alleged for the deposition of Richard the Second? Discuss the claims of Henry the Fourth to the throne.

2. What reasons led Henry the Fifth to declare war against France? Give a sketch of his campaigns.

Geography.

1. Give a list of the different parts of Asia that are under European control, and state the nature of the control.

2. How is the inland trade carried on in different parts of Asia?

Arithmetic.

1. A man found that he had spent on the average on every day of a tour two-thirds as many shillings as the total number of days he had been away from home. If his tour cost him £24, 6s., how many days did it occupy?

2. At a recent examination every candidate took French or Latin, or both; 75·8 per cent. took French, and 49·4 per cent. took Latin. If the whole number of candidates was 2,500, how many took both French and Latin?

3. A horse-dealer bought 76 horses, and then sold 20 at a profit of 15 per cent., 40 at a profit of 19 per cent., and the remainder at a profit of 25 per cent., making a total profit of £657. What did he give for each horse?

Euclid.

1. If a straight line drawn through the centre of a circle bisects a straight line in it which does not pass through the centre, it shall cut it at right angles; and if it cuts it at right angles, it shall bisect it.

If two circles cut one another, any two parallel straight lines drawn through the points of intersection to cut the circles will be equal.

2. In a circle the angle in a semicircle is a right angle; but the angle in a segment greater than a semicircle is less than a right angle; and the angle in a segment less than a semicircle is greater than a right angle.

PQR is a triangle, and QS, RT, drawn perpendicular to PR, PQ intersect in O, and S, T are joined; the triangles QOR, SOT will be equiangular.

3. If from any point without a circle two straight lines be drawn, one of which cuts the circle and the other touches it, the rectangle contained by the whole line which cuts the circle and the part of it without the circle shall be equal to the square of line which touches it.

PQR is a triangle right-angled at R, and from R a perpendicular RS is drawn to the hypotenuse; show that the rectangle PQ . PS is equal to the square on PR.

Algebra.

Solve the equations:—

(*a*) $\begin{cases} x^2 + y^2 = 1843. \\ x^2 - xy + y^2 = 97. \end{cases}$

(*b*) $x^2 + \frac{3}{4} + x - 1\frac{1}{4} = 3\frac{1}{4}$.

(*c*) $\frac{x+2}{x-2} + \frac{x-2}{x+2} = 3\frac{1}{3}$.

Elementary Science.

1. What do you mean by acceleration? A body was moving at the rate of 12 miles an hour at 10.25, and at 15 miles an hour at 10.45; if the foot and second are the units of length and time respectively, what number will measure its acceleration?

2. Show how to calculate the formula for determining the distance moved by a body having a uniform acceleration.

NOTES AND SYLLABUS FOR FEBRUARY.

Composition.

Finish the study of *Figures of Speech* (to the end of Nichol, Part IV., Chap. II.). This must be really mastered, and not merely scanned through. The student must be able to turn a figurative expression into a literal one, and sometimes to turn a literal expression into a figurative one, though the latter is not such a common demand, as in ordinary prose composition figurative expressions which are not in common use, or do not come spontaneously to the writer, are to be avoided. A knowledge of the principles of figurative language makes the study of poetry much more pleasant and profitable.

Prepare essays on—

1. Wild Flowers.
2. "A stitch in time saves nine."
3. The Delhi Durbar.

Theory of Teaching.

Prepare the chapter on object lessons and the teaching of elementary science. Every student should read the ninth appendix to the Revised Instructions to Inspectors, in which the principles underlying object lessons are clearly set out, and lists of subjects are given, suggestive of courses that may be taken up in schools of different types.

One cannot but regret that the term "object lesson" has come to be far too widely and loosely used. The extension shows in the first place the great educational value of object lessons, for that is the chief reason for calling many lessons object lessons which are not object lessons at all. The circular of the Board of Education lays it down that "object teaching leads the scholar to acquire knowledge by observation and experiment; and no instruction is properly so called unless an object is presented to the learner, so that the addition to his knowledge may be made through the senses." And again, "However well the lesson may be illustrated by diagrams, pictures, models, or lantern slides, if the children have no opportunity of handling or watching the actual object which is being dealt with, the teacher will be giving an *information lesson* rather than an *object lesson*." It is a pity that this distinction is not observed in the list of object lessons which follows the excellent advice. This would rule out such subjects as, "The Cow: How she takes her Food," "Preparation for Sleep" (of hibernating animals), and the uses of the tails of animals; for such subjects do not lend themselves to class treatment or direct observation by the pupils in class. We must regard the primary purpose of an *object lesson* as the training in the power of observation. Of course there are other aims, such as imparting useful and interesting information, training in power of reproduction—oral and written composition—etc.; but if these aims are of greater importance than the first, then the lesson becomes an information lesson or a composition lesson.

In the section on school hygiene the month should be devoted to the study of the relation between health and work. This should be regarded from two different points of view. First, the effect of health on the quality and quantity of work. At first sight one would think that the amount of mental work a child can get through is directly proportional to his physical vigour; but this is not so, as a large amount of physical vigour must find an outlet in physical exercise, so that, as a rule, the boy of medium physique will do more mental work than his more robust companion. The second point—the effect of study upon health—must deal with temporary and with permanent effects. The chief temporary effect is mental fatigue; and although downright weariness is, no doubt, a bad thing, a little fatigue, whether bodily or mental, must not be regarded as a great evil. There should be no one-sidedness about the fatigue. If there is, it is better to have bodily fatigue alone rather than mental fatigue alone. In fact, if sufficient open-air exercise is taken in conjunction with the mental work to produce physical fatigue, then mental fatigue will hardly ever be felt.

It is the teacher's duty to watch and see that the pupils

suffer from no mental weariness. The chief symptoms are listlessness, yawning, and in bad cases headache. To prevent fatigue, the teacher must see that the pupils have (1) plenty of outdoor exercise, (2) not an excessive total of work, (3) plenty of variety. We need hardly say that young children are much more susceptible to fatigue than older ones, hence in their case it is still more important to have frequent bodily exercises, to demand a smaller total of work, and to arrange for shorter lessons than in the case of older children. The observant teacher will, however, soon discover that in a class of children working under the same school conditions some will feel fatigue much more readily than others. Outside influences must evidently be taken into account, and the teacher should set himself to discover, by judicious inquiries, what these influences are, and how they act. Among them he may discover improper hours of rest, especially late hours for going to bed: the early risers seldom show signs of fatigue in school, except in the case of those who have to work before coming to school. Newspaper-boys, milk-boys, and cleaners of knives and boots, are much to be pitied in this respect. Improper food, either by nature or by amount, has a great influence on power to resist mental fatigue. Constitution and temperament are important factors: some children are "born tired." The warmth and ventilation of the schoolroom play an important part in the amount of work children can get through without undue fatigue; and in this respect, although the whole class may seem to be subject to the same influence, yet, owing to causes previously mentioned, some children succumb much more quickly than others in an ill-ventilated room. The causes that have been enumerated as leading to temporary fatigue will, if continued, lead to serious permanent evils; but in dealing with these, it is a matter of extreme difficulty to separate the causes over which the teacher has control from the conditions for which he is not responsible. Headaches may become chronic, the physical growth may be arrested, and the mental development, which seems to be making such good progress under the forcing system, undergoes no continuance spontaneously the moment the forcing ceases. But, after all, the principal object of teaching is to give the pupil the power to continue to advance in knowledge, and any system which produces a contrary effect is to be condemned. The common signs of depressed health, such as pallor, anæmia, wasting, stunted growth, and ophthalmia, are often associated with continued mental weariness; but other causes are invariably present as well. So it is possible that undue pressure may aggravate the tendency of a child to tuberculosis; but it is extremely doubtful whether mental work can of itself bring on that terrible disease of children—meningitis.

English Literature.

Study carefully the first book of the *Golden Treasury of Songs and Lyrics*. The preface clearly sets out the principles on which the poems have been selected. We are sure that if our readers set to work in the right way, they will find the study of this volume a true pleasure. Unfortunately the methods of studying literature are much neglected in our schools, hence we feel justified in giving the following advice:—

1. Read the poem carefully through, and master its general meaning. The subject-matter should be analysed, and the purpose of the poem noted, and how the various parts are related to it. Let us take XXXVIII. as an example. In this sonnet a middle-aged lover implores his lady to love him well, because they must soon part, and we have a comparison between the lover and (*a*) the fall of the year, 1–4, (*b*) sunset, and (*c*) the expiring embers. Then comes the moral.

2. Commit the whole, or parts, to memory. The student is advised to select specimens of each form—sonnet, ballad, and ode—as well as striking passages, and store them in his memory.

3. The next step is to deal with the structure of the poem. Beginning with the individual lines, we see that each line contains five feet, each of which consists of an unaccented and an accented syllable. But the accent should be weakened on the words *of*, *on of*, and *the*, in lines 9, 10, and 11. The poem consists of *fourteen* lines, and therefore claims to be a sonnet, although it differs in some points from the true type. All sonnets commence with two groups of four lines, and the editor of the *Golden Treasury* has inserted a space after each group to mark the arrangement; but this is not usual. Generally four of the first eight lines rime together, and sometimes the other four have but one rime. In our example there are four distinct rimes, and so the second quatrain is not related to the first. The last six lines of a sonnet generally form two groups of three lines each, as in CCXCI. The riming scheme of a sonnet can easily be represented by the first few letters of the alphabet; thus CCXCI. is the usual plan, and is represented by *abba abba cdc dcd;* but the scheme of XXXVIII. is *abab cd cd efef gg*. The subject-matter is generally prepared by the statements made in the two quatrains, which are brought into relation in the first terzette, and the point is brought out in the last.

4. We now notice the diction: *choirs* = the place for the choir, like the east end of a church; *by-and-by*, up to Shakespeare's time, meant immediately, not as it now means, in the distant future.

5. Next we must study the figurative expressions. In the first quatrain we have a metaphor founded on the resemblance between age and the fall of the year (give other examples of this metaphor). Within this metaphor is another founded on the resemblance of the place where the birds sing to a "ruined choir." In the next quatrain there is a metaphor founded on the resemblance of the decline of life to the eventide, and on the similarity between death and night. The third section does not throw these into relation in this case, but introduces another metaphor based on the similitude between declining life and a dying fire.

It may seem that we are prescribing a large amount of work to be given to fourteen lines of poetry; but if the reader will only work conscientiously from the first, he will get into a good method, and will find that he will soon be able to work with sufficient speed, and to do the work thoroughly. In preparation for the examination itself, he should acquire the power of showing how he would treat one of the poems in a reading lesson or a literature lesson. It will be noticed that we have said nothing about grammar in connection with the poems. In some cases the rules of grammar may be used to make the meaning clearer, but we object to the use of high-class poetry merely to teach formal grammar.

English History.

Study the reigns of Henry the Seventh, Henry the Eighth, Edward the Sixth, and Mary. The general features of this period are well known, but the following deserve much more attention than they usually receive:—

1. *Poynings' Acts*, 1494.—Two measures passed by the Parliament of Drogheda under the Lord Deputyship of Sir Edward Poynings, the first of which enacted that all laws then in force in England should have equal force in Ireland; the second debarred the Irish Parliament from considering any Bill which had not previously received the approval of the King of England and his council.
2. Act of Supremacy, 1534.
3. The Six Articles.
4. The reasons for the increase of the royal power under the Tudors.
5. The social condition of the English people, and the transition from feudal customs to modern ways of living.
6. The Renascence, or Renaissance—the great forward movement in art, literature, and knowledge.

Geography.

Prepare the physical geography of Africa from a text-book not more than ten years old.

The coast features are generally well known, but the islands often receive scanty attention, because of the great distance of most of them from the mainland. Not only should Madagascar, Cape Verde Islands, Fernando Po, and Socotra be studied in connection with Africa, but also the islands of Madeira, the Canaries, Ascension, St. Helena, Bourbon, and Mauritius.

The elevations should be studied rather as tracts than as ridges; and the general build of the continent, particularly of South Africa, must be mastered.

The deserts form a special feature of Africa, the Sahara covering an area of no less than 2½ million square miles. The Egyptian Desert is separated from the Sahara by the valley of the Nile, but is often considered as part of the Sahara. There are many desert tracts of greater or less extent in South Africa, such as the Kalahari Desert.

The interior of the map of Africa was filled in by early geographers with all sorts of mountains and rivers, which explorers soon found not to exist. Consequently they were all deleted, and the maps of Africa of about forty years ago were printed with almost a blank in the middle. The work of explorers has added to our knowledge little by little, until at the present day the geography of the chief features is fairly well known. The reader will find the following information respecting their discovery of great assistance in studying the great rivers and lakes.

1. *Nile.*—The lower part was known to the ancients, and on its banks flourished that wonderful civilisation—the Egyptian.

The first of what we might call modern explorers was a Scotsman, James Bruce, who explored the Nile valley; but at Khartum he struck up the Bahr-el-Azrek, or Blue Nile, which he thought to be the principal stream. He traced this branch right to its source, and after exploring Abyssinia, reached Massowah on the Red Sea. He published an account of the things he saw in his travels, some of which were so wonderful that the celebrated *Adventures of Baron Munchausen* were thought to be a travesty of them; but they did much to stir up an exploring spirit in others. In 1858, Captain Speke, after visiting Lake Tanganyika with Burton, discovered the southern shore of the Victoria Nyanza; and in 1861, Speke and Grant explored the western shores of the lake, and discovered the White Nile issuing from the northern end. Three years later the Albert Nyanza was discovered by Sir Samuel Baker. Albert Edward Nyanza was explored, and shown to be connected with the Albert Nyanza, by Stanley in 1888, who also explored much of the district near the head-waters of the Nile.

2. *Niger.*—The course of this river was traced almost to its source by Mungo Park, a Scotsman, about a hundred years ago.

3. *Orange River.*—Most of our information respecting the Orange River is due to the explorations of the Scotch missionary, Robert Moffat, between 1817 and 1860.

4. *Zambesi.*—The mouth of this river was discovered by Portuguese navigators, but in 1850 Livingstone struck upon it in its middle course, and in 1852 traced its course up for many miles, and worked his way across to Loanda. In 1854 he was again exploring the Zambesi, and worked his way down to Quilimane at its mouth. Two years later he started on his great journey, and explored the country north of the Zambesi; traced the Shiré up to Lake Nyassa, which he carefully explored. He also explored Lake Tanganyika, previously discovered by Burton and Speke; he discovered the Chambezi, and traced its course into Lake Bangweolo. He then traced the course of the Luapula, which runs out of Lake Bangweolo, up to its entry into Lake Mooro. He thought that this lake formed the head-waters of the Nile, but Stanley afterwards showed that it was drained by the Congo.

5. *Congo.*—After finding Dr. Livingstone at Ujiji in 1871, Stanley undertook another expedition in 1874, and after again visiting the country near the Albert Nyanza, he followed the course of the Lualaba, which Livingstone had thought to be connected with the Nile, and showed that it was one with the Congo. In 1880-2 he explored a great deal of the basin of the Congo.

Arithmetic.

Finish percentages, including the rules in which time has to be taken into account—namely, interest (simple and compound) and discount. Many students find a difficulty in dealing with problems involving "covered" insurance—that is, the system of insurance by which, in case of loss, the insurer will recover not only the value of the goods, but also the money he has paid in premiums. This difficulty will vanish if the student takes as his starting-point the money to be received in case of loss.

Example.—For how much must a person insure goods worth £1072, 10s., at 2½ per cent., so as to recover both the value of the goods and the premium in case of loss?

Imagine a case in which a man would receive £100 in case of loss; then he would have paid £2½ to insure for this amount, and consequently the goods would be worth £97½. Therefore, if £97½ worth of goods must be insured for £100, then £1072, 10s. worth of goods would be insured for

$$\frac{1072\frac{1}{2}}{97\frac{1}{2}} \text{ of } £100 = £1100.$$

In discount, care must be taken to understand the principle, and avoid rule-of-thumb work. The text-books too often give the rule beginning, "Find the amount of £100, etc.," without showing why the amount of £100 is selected. The first step in understanding discount is to grasp the fact that if we know the discount of one sum of money under given conditions, we can by proportion find the discount on any other sum under the same conditions. Now the interest on £100 is evidently the discount on the amount of £100, hence whatever multiple or fraction of the amount of £100 we take, its discount will be that same multiple of the discount on the amount of £100—that is, of the interest on £100. We select the amount of £100 because that is an easy sum on which to calculate the discount if we have the time and rate per cent. given us; but sometimes the discount on a given sum is stated, and we are required to find the discount on another sum. To a student who understands the principle of discount that is easier than a problem with time and rate stated, but the student who works mechanically cannot fit his rule in.

The difference between true and banker's or commercial discount requires attention. Banker's discount is applicable only for short periods. The absurdity of supposing that it could be used in calculations for long terms is evident on trying to work such an example as the following:—Find the present worth of £100 due in twenty-five years, interest being at 4 per cent. per annum. If we calculate "banker's discount" in this case we find that the discount is £100, and we should be led to state that £0 at the present would amount to £100 in twenty-five years—an evident impossibility. The student must notice that although the true discount is greater the longer the time, yet the two are not proportional. Quantities are not proportional merely because one becomes greater when the other becomes greater, but four quantities are proportional when the first is the same multiple (or fraction) of the second as the third is of the fourth. Now since the discount becomes greater the longer the bill has to run, the present worth (which is the sum left after deducting the discount) becomes less the longer the bill has to run, and is consequently less able to bear interest. Hence, since the discount is the interest on the present worth, and interest depends not only on time but also upon principal, it follows that the discount cannot be proportional to the time, as the interest on a fixed principal is.

Euclid.

Prepare the first ten propositions in Book IV. The first nine are simple, although some are rather long. The tenth is a very fine proposition, and is best remembered if it is analysed. Suppose the isosceles triangle ABC has been constructed, having each of the angles at the base double the angle at A. Bisect the angle ACB by a line meeting AB in D. Then BCD is equal to DAC, and therefore, by the converse of III. 32, BC must be a line touching the circle which circumscribes the triangle ADC. Therefore, by III. 36, the rectangle AB · BD is equal to the square on BC; but (by I. 6) ADC and BDC are isosceles triangles, and therefore BC = DC = AD. This shows us how to find point D (II. 11), which is the starting-point of the whole proposition.

Algebra.

Work problems involving quadratics. This will give some capital practice in symbolical expression, and also in solution of quadratic equations.

Elementary Science.

The laws of motion are three statements drawn up by Newton. They are as follows:—

1. Every body continues in a state of rest or of uniform motion in a straight line, except in so far as it may be compelled to change that state by force acting on it.

2. Change of motion is proportional to the acting force, and takes place in the direction of the straight line along which the force acts.

3. To every action there is always an equal and opposite reaction; or the mutual actions of any two bodies are always equal, and take place in the same straight line, but in opposite directions.

The syllabus requires a special knowledge of the first and second law. It states that the first law defines force, but this is hardly a complete description of the law. Force is one of those fundamental things, like time, which seem to defy definition, although we define it by referring to the effects it produces, and say that "Force is that which changes, or tends to change, the state of rest or motion of a body." We might rather say that the law defines *inertia*. For the inertia of a body is that property by virtue of which it remains in the same state of rest or motion, except in so far as it may be compelled to change that state by force acting on it. Here we see that our definitions proceed in a circle; for we practically say, "Force is that which alone can overcome inertia," and "Inertia is that which can be overcome by force alone," which reminds us of the definition of a *straight line* as the *shortest distance* between two points, while the shortest distance between two points is defined as the length of the straight line joining them. The second law does give us a means of measuring force, provided we bear in mind that "change of motion" in order to be measured must be considered in connection with (1) the mass of the body whose motion is changed, (2) the acceleration produced in it. Thus, if two bodies starting from rest acquire, under the action of forces acting respectively on them, the same acceleration, then the forces are simply proportional to the masses of the bodies. On the other hand, if the bodies were of the same mass, the forces would be proportional to the accelerations produced. If both the mass and the acceleration are different, we have a compound proportion, and the forces are proportional to the masses and accelerations conjointly. This is denoted by the formula $F = Mf$.

OUR SCIENCE SECTION

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PHYSIOGRAPHY.

(ADVANCED AND HONOURS.)

Meteoric Iron from Surprise Springs, California.—The figures which follow refer to the analysis of a specimen of meteoric iron, weighing 1,524 grams, which was found in 1899 at Surprise Springs, near Bagdad, in San Bernardino, California. It is octahedral in structure, and has a specific gravity = 7·7308.

Analysis.

Fe 91·01.	Cr 0·04.
Ni 7·65.	S 0·08.
Co 0·89.	P 0·22.
Cu 0·07.	C and Cl each 0·02.

Rainfall for 1902.—During 1902, the rainfall in all parts of the British Isles was below the average, the deficiency in several districts being unpleasantly large. The worst sufferers have been south-west and north-west England, that finished the year with arrears amounting to 8·2 in. and 7·1 in. In Scotland north, east, and west, the shortage was 5·0 in., 5·6 in., and 0·1 in. England north-east and east were behind by 4·2 in. and 3·4 in.; while in the Midlands and south England the defect was 3·9 in. and 3·4 in. North and south Ireland were below the average by 0·8 in. and 5·3 in. In the Channel and Scilly Isles the year's rainfall was short by 5·8 in. Similarly, therefore, to its predecessor, 1902 is to be classed among the dry years.

A Notable Meteorite.—In an exhaustive memoir, relative to the Mexican meteorites, which was published in the *Mineralogical Magazine* in 1890, Mr. Fletcher called attention to the fact that a large mass of meteoric iron, found in 1867 in an ancient grave at Casas Grandes de Malintzin, Chihuahua, Mexico, and thus of much archæological interest, had not been heard of since 1873, in which year it was said to be about to be transported from Casas Grandes to the United States consulate at El Paso. Mr. Fletcher suggested that the missing mass was possibly identical with one which had been shown in the Mexican mineral exhibit at the United States International Exhibition of 1876, and had been afterwards transferred to the Smithsonian Institution. On investigation, the Washington authorities were convinced that the suggestion was well founded. Mr. Wirt Tassin has now published a description of the mineralogical and chemical characters of the mass. Very sharply defined Widmanstätten figures are developed by the etching of a polished face. The percentage of nickel (and cobalt) varies in different parts from 4·5 to 5·3. The chemical composition of one of the alloys (tænite) corresponds to the formula Fe_6Ni. As is usual in meteoric irons, both troilite (ferrous sulphide) and schreibersite (phosphide of iron and nickel) are present; both minerals were isolated and analysed. Cliftonite, the cubic form of graphitic carbon, was carefully sought for, but only massive graphitic carbon was found.

Kirchoff's Experiment and Stokes's Law. (Reply to "F. E. D." and several others.)—You will find these two matters dealt with in any good modern treatise on light. In addition to the books already mentioned in our last issue, we recommend Edser's *Light*, from which the following extracts are taken.

Kirchoff's Experiment.—"Kirchoff formulated the following important law: '*A substance which emits waves of definite periods when heated, will selectively absorb waves of the same period when cool.*' This law was arrived at by a study of the absorption of sodium vapour. As already stated, incandescent sodium vapour emits light corresponding to two adjacent lines (the D lines) in the yellow part of the spectrum. According to Kirchoff's law, sodium vapour should also absorb light corresponding to these two lines. That it does so may be proved by the following experiment: 'Illumine the slit of a spectrometer with limelight. A bright, continuous spectrum is thus formed. Now place the flame of a spirit lamp (the wick of which has been previously soaked in salt solution and then dried) immediately in front of the slit, so that the white light has to traverse the spirit-lamp flame before reaching the slit. Two narrow black lines, exactly coinciding with the position of the D lines, will be seen in the spectrum.' Then follows the application of the principle to the Fraunhofer lines, for which our readers must consult the book itself.

Stokes's Law.—"As a general rule, when light is absorbed by a body, its energy becomes transformed into molecular motion or heat. In certain cases the absorbed light gives rise to new light waves, generally of a particular wave-length, or at least confined between comparatively narrow limits in the spectrum. This phenomenon is termed *fluorescence*. As a general rule, the violet and ultra-violet parts of the spectrum are most active in producing fluorescence. Sir George Stokes investigates this point as follows: He formed a pure spectrum on a screen, using sunlight or the electric arc as an illuminant, the prism and lenses employed being of quartz. A strip of white card, which had been painted thickly with a paste made from sulphate of quinine moistened with a little sulphuric acid, was placed beyond the violet end of the spectrum; it was found to fluoresce brightly, emitting a blue light. A number of dark bands, similar to the Fraunhofer lines in the visible spectrum, were observed. The visible parts of the spectrum were practically inactive in producing fluorescence in sulphate of quinine..... From his experiments, Sir George Stokes was led to frame the following law: '*When the refrangibility of light is changed by fluorescence, it is always lowered, and waves raised.*' In other words, the waves emitted during fluorescence are always longer than those absorbed, and thus give rise to fluorescence. Certain exceptions to this rule occur; these may be explained by assuming that, in cases where Stokes's law is not obeyed, some sort of chemical reaction occurs."

The Structure of the Universe (Dr. Osborne Reynolds).—It is admitted that all space must be filled with some medium which transcends the various influences which we know as radiant energy; for Newton's own theory that they might consist in the actual transmission of material particles has been completely disproved. The luminiferous ether has held its ground, because it was adequate to explain most of the phenomena; but it has always been felt that our inability to assign any way in which it could possibly transmit the attraction of material bodies for one another, which we call gravitation, was a serious deficiency. Indeed, no one has yet assigned a cause for gravitation—the fundamental property of matter, as we know it—which is even plausible. Such theories as Le Sage's bombardment of corpuscles or Lord Kelvin's hypothesis of "sinks" and "sources" of matter have been set aside, on the double ground that we have no proof of their existence, and that they presuppose such an incredible development of energy as to be exceedingly improbable. But Dr. Osborne Reynolds tells us that his new theory of the universe accounts for gravitation on Newton's original hypothesis that it is the effect of a state of stress in the medium surrounding all bodies.

What the Medium is.—That medium, as Dr. Reynolds believes he has discovered it, is not the homogeneous, infinitely rare jelly which is understood by those who have hitherto spoken of the ether, but a definite granular structure, comparable to an illimitable heap of shot or sand piled in a regular fashion, so that each grain is at the same distance from each of its twelve neighbours. By a method which is only intelligible to trained mathematicians, Dr. Reynolds has been able to work out from his experiments a complete series of measures for the grains of this primordial substance which he believes to fill all

space. We are told that the size of these grains is inconceivably small, though it has been definitely measured by mathematical analysis as being the seven-hundred-thousand-millionth part of the wave-length of violet light—a unit which is itself equal to the sixty-thousandth part of an inch. In a normal condition, these grains are in motion with a mean relative velocity of about one and one-third feet per second, though the mean path of each grain is restricted by its neighbours to the four-hundred-thousand-millionth part of its own diameter. From this it follows that the mean density of such a medium must be ten thousand times that of water, or four hundred and eighty times greater than that of the densest matter known on the earth, whilst it must be normally in a state of stress such that its mean pressure is seven hundred and fifty thousand tons on the square inch, or three thousand times greater than the strongest material known to us can bear. If now the reader will try to conceive the real meaning of Dr. Reynolds's assertion that the whole of space which we call empty is filled by this extraordinary medium, he will have some idea of the epoch-making nature of this discovery.

Conclusion.—Dr. Reynolds goes on to state that the assumption of such a medium affords a complete, quantitative, purely mechanical explanation of the cause of gravitation. This cause is found in the tendency of any system of grains arranged in the hypothetical manner to expand under pressure—a tendency most ingeniously illustrated by the behaviour of india-rubber bags filled with sand and water, one of which the author proudly calls "the first experimental model universe." Another almost equally striking consequence is that the hypothesis gives us "a purely mechanical explanation of electricity."

What is Matter?—What then, one asks, is matter? The answer to this question also is ready, and not wholly novel to those who are familiar with Lord Kelvin's beautiful theory of vortex atoms. Matter, as we know it, is simply a mode of motion in the assumed granular medium. "We are all waves," says Dr. Reynolds; and it remains for men like Lord Kelvin and Sir Oliver Lodge to test the truth of this bold, beautiful theory which we have quoted from the *Observatory*.

CHEMISTRY.

(ADVANCED AND HONOURS.)

BY T. CARTWRIGHT, B.A., B.SC.

Some Recent Electric Furnace Products.—Although the pulverisation of metals in the electric furnace forms the subject of several patents issued in this country and abroad, but little is known of the practical operation of the methods or the nature or use of the several products obtained.

The general method is simple in the extreme, says the *Electrical World*. A metal is heated either by the arc or by the passage of a heavy current through a column of reduced cross section, and is thereby brought to the temperature of volatilisation. Vapours so produced are, in most cases, directly combustible in air, burning freely to oxide, or may be subjected to various reagents with corresponding variety in the products; or, finally, the metal may be collected directly in comminuted form in an inert atmosphere.

The applications of the method embrace the manufacture of a whole series of pigments, abrasives, refined metals, and miscellaneous reagents.

In 1896 the Société Civile d'Etudes du Syndicat de l'Acier Gerard of Paris patented abroad a method designed primarily for the production of steel from iron by a modified Bessemer process, the principal feature of which was the comminution of the metal before subjecting it to a graduated blast of air, the effect being, as in the converter, the oxidation of silicon, sulphur, phosphorus, and carbon, and the conversion of pig metal into steel.

As one method of pulverisation, the employment of the arc was suggested, the fused metal falling in a stream between the circuit terminals, and collecting after passing through an air-blast in the hearth of the furnace.

Later, a modified construction was adopted wherein a metal formed a short circuit between water-cooled terminals, and the air-blast was projected against its surface at the point of maximum temperature. The vapour was thereby oxidised, and carried over to a collecting chamber forming a part of the furnace.

The substitution of other metals for pig iron suggested at once several modifications of this process—to wit, the comminution of lead for use in accumulators; the production of litharge by the concurrent oxidation of the lead; the production of zinc as a sublimate, or, in the presence of an air-blast, of zinc with the production of rich mattes of copper, or the pulverisation of this metal as a preliminary to the extraction of the contained values; the production of powders of bronze, tin, and aluminium, which enter in many ways into industrial processes; and, finally, the comminution of chrome—or tungsten—steels, to serve as abrasives.

An analogous procedure for the manufacture of white lead has been patented in this country by Messrs. Bailey, Cox, and Hey. In this process the arc is struck from a tabular electrode to the surface of a mass of molten lead. Commingled vapours of water, carbon dioxide, and acetic acid, introduced through the hollow electrode, are presumed to react with the vaporised lead to form commercial white lead; the function of the acetic acid in this process is not clear, and its use is probably merely a relic of various prior methods operating at temperatures at which the acid is stable.

Messrs. Bredig and Haber have noted in the *Berichte* a curious phenomenon which occurs when the arc is struck beneath the surface of the electrolyte, either acid or alkaline, to a lead wire cathode, or when high cathode current densities are used under these conditions; the metal is disintegrated, appearing as a cloud in the solution, and white lead may, it is said, be produced by merely injecting air and carbon dioxide. The method is, of course, not a commercial one.

Recently M. Barry of Paris patented a furnace for the commercial production of stannic acid. The molten metal is included as a resistance in the circuit, and the vapours as they escape from an orifice in the furnace cover are ignited by an air-blast and the dioxide collected.

The Tin Electro-Smelting Company, Limited, of Paris, which controls this patent, is also marketing a series of pulverised metals, presumably made in an analogous manner. These are an impalpable powder of tin, known in France as argentine, and capable of giving, by simple rubbing, a burnished foil-like surface to paper; several grades of pulverised aluminium, the finest constituting the base of a new high explosive, and the coarser grades adapted for use in thermite reactions, as, for instance, the reduction of oxide of chromium, etc.; and pulverised lead, employed for the manufacture of minium, of white lead, and particularly for the production of sodium nitrite.—*Invention.*

Coal Gas.—To facilitate the distillation of coal in gas-manufacturing processes, and to obtain a higher percentage of hydrocarbons, a known plan is to admit water-gas to the retorts. A new process consists in so regulating the admission of the water-gas that most of it is admitted at the commencement of the distillation — that is, during the time that the heavy hydrocarbon gases are being evolved in the greatest quantity. The amount is then diminished in proportion as the amount of the heavy hydrocarbon evolved diminishes, and is cut off entirely at the end of the second hour. The total volume of water-gas admitted must not exceed about one-third the total volume of gas evolved.

New Use for Aluminium.—Yet one more use for aluminium—namely, the sharpening of cutlery. The discoverer of this new use—a Hamburg engineer—has found out that, although a metal, aluminium has the structure of a fine stone, and possesses a fine dissolving power. During the whetting process it develops a fine metal-setting substance, greasy to the touch, and showing strong adhesiveness to steel.

Transformation of Pyrophosphoric Acid into Orthophosphoric Acid.—M. Grian states that when pure crystals of pyrophosphoric acid are prepared from the syrupy acid having the theoretical composition $P_2O_7H_4$, and this is kept for some time at a temperature of -10°, the acid crystallises out in little white grains of spheroidal form. The author measures directly the heat of solution of this crystalline acid :—

$$P_2O_7H_4 \text{ crys.} + \text{aq.} = P_2O_7H_4 \text{ diss.} \ldots\ldots + 7{\cdot}93 \text{ cals.}$$

He then finds the heat evolved during the transformation of solid pyrophosphoric acid (liquid or dissolved) to orthophosphoric, and obtains the following result :—

$P_2O_7H_4$ liq. + H_2O liq. + aq. = $2PO_4H_3$ diss. . . . . + 14·47 cals.
$P_2O_7H_4$ sol. + H_2O liq. + aq. = $2PO_4H_3$ diss. . . . . + 12·35 cals.

The difference in these two numbers gives the heat of fusion of the pyrophosphoric acid.

New Method for Preparation of SO_3.—Instead of using platinised asbestos as the agent used to promote combination between SO_2 and O, a process has been patented in France whereby asbestos saturated with phosphoric acid solution is used for this purpose. It is claimed that the saturated asbestos is so effective as to oxidise 90 per cent. of the SO_2 to SO_3.

Reactions in the formation of CaC_2.—Free oxygen is found in the gases formed in the hottest portion of a calcium carbide furnace, whilst calcium vapour is found in cooler por-

tions of the furnace. Mr. G. Gin suggests that these substances may be formed by the reactions—

$$2CaO + 4C = 2CaC_2 + O_2; \text{ and}$$
$$CaC_2 + 2CaO = 3Ca + 2CO,$$

the temperature in the hottest zones of the furnace being higher than the dissociation temperature of carbon monoxide.

Crystallised Hydrogen Peroxide.—Herr Wilhelm Staedel states that when a concentrated solution of hydrogen peroxide is cooled, it solidifies, and the crystals melt at − 2°. A 90 to 95 per cent. solution remains liquid at − 20°, but solidifies in a freezing-mixture of ether and carbon dioxide. The entectic point lies between − 20° and − 23°. The crystals, which are anhydrous, are colourless and prismatic. The best method of obtaining anhydrous hydrogen peroxide is by this freezing-out process. When a trace of platinum sponge or manganese dioxide is thrown on to the anhydrous preparation, an explosive decomposition takes place; a mixture of powdered carbon or magnesium with a trace of manganese dioxide inflames when dropped on to it. When a 90 to 95 per cent. solution of hydrogen peroxide is added to a concentrated solution of calcium chloride, silky crystals separate, which contain 23 per cent. of hydrogen peroxide.

Direct Hydrogenation of Nitrogen Oxides by Contact Action.—MM. Paul Sabatier and Jean B. Senderens have published in *Comptes Rendus* the following particulars of these interesting reactions:—When a mixture of nitrous oxide and hydrogen is passed over reduced nickel, a reaction takes place at the ordinary temperature with a large development of heat, and in presence of excess of hydrogen the oxide is completely reduced without any formation of ammonia. If the oxide is in excess, the front part of the metal becomes incandescent, higher nitrogen oxides appear in the cooler part of the tube, and a little ammonia is formed. With excess of nitric oxide, the metal becomes incandescent. Reduced copper behaves in the same way as nickel, but reduction does not take place below 180°. Mixtures of nitric oxide with excess of hydrogen are not reduced by nickel below 180°; but above this temperature water, ammonia, and nitrogen are formed. With excess of nitric oxide the metal becomes incandescent. Copper behaves in the same way as nickel. With nitrogen peroxide and hydrogen the phenomena are similar; but if the proportion of the peroxide is increased, ammonium nitrite and nitrate are formed as well as ammonia, and when the proportion exceeds a certain limit the metal becomes incandescent, and an explosion usually occurs. Mixtures of nitric acid vapour and hydrogen are reduced in a similar manner.

Dialysis of Metallic Hydroxides and Sulphides.—When an alkaline solution of aluminium, lead, or stannous hydroxide is placed in a dialyser, no precipitate is formed on the parchment, and the metallic hydroxide easily passes through. With similar solutions of beryllium and zinc hydroxides, the colloidal substance does not diffuse so readily, and there is a precipitation of the hydroxide on the membrane; with chromium hydroxide there is no diffusion. This is in agreement with Hantysch's view that aluminium, lead, and stannous hydroxides are acids, beryllium and zinc hydroxides are weak acids, and chromous hydroxide has no acid properties.

When the brown solution obtained by dissolving nickel sulphide in ammonium sulphide is subjected to dialysis, the nickel partially diffuses; but there is a large deposit of nickel sulphide on the membrane. This shows that the solution is not a colloidal one, in the ordinary accepted meaning of the term.

The Future of Aluminium.—At the Paris Exhibition of 1855 was shown a curiosity—a small bar of aluminium, said to represent its weight in gold. In 1867 the sodium process was invented, and about a metric ton per year of aluminium was made, at a price of about £3 a pound. In 1889 the improvements made by Caster and Netto in the manufacture of sodium began to affect the price of aluminium. Its selling price dropped to about 25s. a pound. Then came, in 1889, the electrical processes of Héroult and Hall, producing pure aluminium. These processes drove the sodium processes clear out of the market. The annual output has risen from 70 to 7,000 tons a year, and the cost has fallen from 25s. to 1s. 3d. a pound. Such a transformation in a couple of years is probably unique in the annals of industrial science. Aluminium is now more fully within our reach for ordinary commercial purposes than are silver, brass, and copper. Already in the United States there is more aluminium produced than either nickel, mercury, bismuth, tin, or antimony. The main centres of the industry are at the Niagara Falls, the falls at Foyers, in Scotland; at Neuhausen, in Switzerland; and at La Praz and St. Michel, in Savoy. New plants are now being laid on the banks of the St. Lawrence, in Canada; on the Rhine; and at Salzburg, in Austria. When the latter are in working order, the total capacity of all the firms will be 47,000 horse-power, with an annual output of 10,000 tons. It will then be cheaper to make an article in aluminium than in any metal except zinc, lead, or iron.

The Molecular Condition of Borax in Solution.—Borax is slightly hydrolysed into sodium hydroxide and boracic acid. Experiments on the diminution of conductivity on the addition of further quantities of boracic acid show an increase of this hydrolysis when further diluted with water, and also with increase of temperature. In N/10 solution, the hydrolysis was estimated by Shields to be 0·5 per cent. at 25°, and the experiments of the author with N/200 solution showed 4 per cent. at 25°, and 6 per cent. at 50°. Kahlenberg and Schreiner concluded from freezing-point determinations that six chemical individuals are present in a dilute solution of borax.

These chemical individuals seem to be $2H_3BO_3 + 2Na - BO_2$, as shown by the following equation:—

$$Na_2B_4O_7Aq + 3H_2O = 2NaAq + 2BO_2Aq + 2H_3BO_3.$$

The author has confirmed this by a number of direct experiments, amongst which the most important is the precipitation of $AgBO_2$, and determination of the boracic acid remaining in the solution.

Quantitative Wet-Testing. (Reply to "A.E.H.")—By "wet-testing" I suppose you mean titration. There is no special book, and I do not see that any special book is required, since all books in quantitative analysis give sections on volumetric analysis; and all that you have to do is to go over these various methods for the different metals, and to have ready reliable standard solutions on the examination day. It is here, however, that you are likely to deceive yourself in thinking that volumetric work is speedier than gravimetric. The actual work of titration takes little time, it is true; but if you have to prepare your own standard solution you will find it wiser to do your analysis gravimetrically. The best course to follow will be to divide your reactions into two classes, namely, those that are readily done by easily-prepared standard solutions—such as iron; and those best done gravimetrically—such as lead. In the complete analysis of an ore it is usual, and even necessary, to employ gravimetric methods for some of the constituents, and volumetric methods for others; hence the wisdom of practising both modes of procedure. If the above does not meet your case, please write again stating a specific analysis, when I will give a more specific reply.

ELECTRICITY AND MAGNETISM.

(ADVANCED AND HONOURS STAGES.)

BY EDWIN EDSER, A.R.C.S., F.PH.S.

Electrical Distribution of Energy.—By means of the electric current it is possible to distribute energy, generated at any convenient spot, over a considerable area, so that it may be utilised at points at a considerable distance from the generating station. It is impossible to avoid some loss of energy in this process, but this loss can be made as small as we please by giving a sufficiently large cross-sectional area to the conducting mains. Consideration will now be given to a few problems connected with this aspect of electro-technics.

In the electric glow-lamp a conducting filament is rendered incandescent by means of an electric current which traverses it, and part of the electric energy which is dissipated is transformed into the energy of light waves. The filament commonly used is of carbon, its ends being electrically connected to two platinum wires sealed into the walls of a glass vessel. The vessel is thoroughly exhausted, so that the carbon filament cannot burn when heated, and heat cannot be carried away from it by any process save radiation. The candle-power of the glow-lamp depends on the rate at which energy is dissipated in the filament. Roughly speaking, three watts are required for each candle-power of a well-constructed glow-lamp, or a sixteen candle-power glow-lamp, when connected across the mains of a hundred volt circuit, requires half an ampère of current. Glow-lamps can be constructed for circuits of various voltages, from a few volts up to 210 volts; but when once made, a glow-lamp requires a certain definite voltage to be maintained across its terminals if light is to be economically generated. If the voltage across the terminals of a lamp rises much above its normal value, the filament will be destroyed, the carbon being vaporised by the excessive heat; if the voltage falls below its normal value, the filament is only raised to a red heat, and most of the energy dissipated is radiated in the form of red and infra-red ether waves. Thus the primary condition to be

complied with is, that electric energy shall be supplied at a constant voltage.

To attain this end the electric energy may be generated by a shunt-wound dynamo, which, as we have seen, produces a current at an approximately constant voltage. The terminals of the dynamo are connected to two leads of large sectional

Fig. 1.

area, and the lamps are connected in multiple arc across these leads. In Fig. 1, D represents the generating dynamo, AB and CE represent the leads or mains, while the small circles represent lamps connected across the leads.

If all of the lamps are disconnected, so that the external circuit of the dynamo is not completed, the P.D. between the ends of the mains will be equal to the E.M.F. generated by the dynamo. There is no current in the mains, and consequently there is no drop of voltage along them. As one after another of the lamps is connected across the mains, the current flowing along the mains increases, and the P.D. between the ends of the mains falls below the E.M.F. generated by the dynamo. Let us first suppose that the lamps are all connected across the ends of the mains (Fig. 1); then, knowing the current required for each lamp, and the number of lamps connected across the mains, we know the current which must be generated by the dynamo; and if we multiply this current into the resistance of either main, we obtain the drop of voltage in that main. On subtracting the drop of voltage in both mains from the E.M.F. generated by the dynamo, we obtain the P.D. between the ends of the mains remote from the dynamo.

Problem.—One hundred 16 candle power lamps, each requiring half an ampère at 100 volts, are connected across the ends of two mains, each possessing a resistance of 0·05 ohm. If the generating dynamo produces an E.M.F. of 100 volts, what will be the P.D. between the terminals of each lamp?

Each lamp requires 0·5 ampère, so that the total current in each main will be equal to 50 ampères approximately. As a matter of fact, the filament of one of the lamps will be traversed by a current of 0·5 ampère only when the P.D. across its terminals amounts to 100 volts, and the actual P.D. across the terminals of a lamp will be something less than 100 volts, so that the current actually taken by each lamp will be slightly less than 0·5 ampère. However, for practical purposes it is unnecessary to go into refinements on this point.

Drop of voltage in each main $= 50 \times 0{\cdot}05 = 2{\cdot}5$ volts. P.D. between ends of mains $= 100 - (2 \times 2{\cdot}5) = 95$ volts.

Under the conditions prescribed in the above problem, it is easily seen that 5 per cent. of the energy generated by the dynamo is wasted in heating the mains, while the remaining 95 per cent. of the energy is usefully employed in rendering the lamp filaments incandescent.

Problem.—If, in the preceding problem, the lamps had been uniformly distributed along the mains (Fig. 2), instead of being

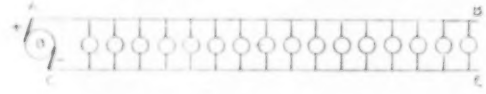


Fig. 2.

connected across the ends of the mains, what would have been the P.D. across the terminals of the lamp farthest from the dynamo?

In this case, as in the preceding problem, a current of 50 ampères leaves the positive terminal, and the same current enters the negative terminal of the dynamo. On passing along the + main AB (Fig. 2), half an ampère flows across to the − main through the first lamp, so that only 49·5 ampères flow along either main between the points to which the first and second lamps are connected. At the second lamp another half ampère of current is tapped off, so that between the points of either main to which the second and third lamps are connected there is only a current of 49 ampères. Thus, as we proceed along either main, the current flowing along that main is continually reduced, till at the extreme end of the main the current sinks to zero value.

Now, if the whole of the 50 ampères flowed along each main, the drop of voltage per main would be 2.5 volts, as calculated in the preceding problem. In the present case, since the current in either main progressively decreases from 50 ampères at the dynamo end to 0 at the remote end of the main, and the drop of voltage per unit length of a main is directly proportional to the current, we may find the total drop of voltage in either main by multiplying the *average current* (that is, $\frac{50}{2}$ ampères) per main into the resistance of the main. Thus, in either main there is a drop of

$$\frac{50}{2} \times 0{\cdot}05 = 1{\cdot}25 \text{ volts},$$

so that the P.D. between the terminals of the lamp most remote from the dynamo is equal to $100 - (2 \times 1{\cdot}25) = 97{\cdot}5$ volts.

Problem.—In the preceding problem what must be the sectional area of each main if the length of either is 1,000 yards? Given that the resistance between opposite faces of an inch cube of copper is equal to 0·66 microhm (that is, $0{\cdot}66 \times 10^{-6}$ ohm).

The resistance of either main is 0·05 ohm. If the main were of 1 sq. in. sectional area and 1 in. long, its resistance would be $0{\cdot}66 \times 10^{-6}$ ohm. Further, the resistance of a conductor varies directly as its length, and inversely as its sectional area. Thus we may write

$$R = \frac{\sigma l}{a},$$

where R = resistance of conductor of length l and sectional area a, σ = resistance per unit length of a conductor of unit sectional area.

Thus,

$$a = \frac{\sigma l}{R}.$$

$$\therefore a = \frac{0{\cdot}66 \times 1000 \times 36 \times 10^{-6}}{0{\cdot}05} = 0{\cdot}475 \text{ sq. in.}$$

Problem.—A point in a distributing network of conductors is fed by a pair of feeders from a generating station 600 yds. distant. On turning on a motor which allows 25 ampères to flow on the first contact, the pressure at the ends of the feeders falls 5 volts:

(*a*) what is the resistance of the feeders?

(*b*) what is their cross-section?

The resistance of a cubic inch of copper may be taken as 0·66 microhm.

(City and Guilds of London Examination in Electric Lighting and Power Transmission, Ordinary Grade, 1900.)

(*a*) Let r be the resistance of the two feeders; then, since a current of 25 ampères, when flowing along these feeders, produces a drop of 5 volts, we have—

$$25 \times r = 5.$$

$$\therefore r = \tfrac{1}{5} = 0{\cdot}2 \text{ ohm.}$$

Each feeder, therefore, has a resistance of 0·1 ohm.

(*b*) Let a = cross-sectional area of either feeder. Then, since length of either feeder = 600 yds. = 600 × 36 ins., we have—

$$a = \frac{0{\cdot}66 \times 600 \times 36 \times 10^{-6}}{0{\cdot}1} = 0{\cdot}142 \text{ sq. in.}$$

Problem.—If the resistance of a cubic inch of copper is 0·66 microhm, and the diameter of each of a pair of wires be 0·064 in., what length of circuit can be used so that the drop shall be 2 per cent. when the pressure between them at one end is 200 volts, and the current flowing through lamps connected between the wires at the other end is 2 ampères?

(City and Guilds, Ordinary Grade, 1901.)

Two per cent. of 200 volts = 4 volts = permissible drop. Thus there must be a drop of 2 volts in each wire.

Let R = resistance of each wire. Then

$$2 \times R = 2. \quad \therefore R = 1.$$

Let l = length of either wire in inches. Then, as already explained,

$$R = \frac{\sigma l}{a}. \quad \therefore l = \frac{Ra}{\sigma}.$$

Diameter of wire = 0·64 in. $\therefore$ Radius r of wire = 0·32 in. Sectional area of wire $= \pi r^2 = 3{\cdot}14 \times (0{\cdot}32)^2 = 0{\cdot}321$ sq. in.

$$l = \frac{1 \times 0{\cdot}321}{0{\cdot}66 \times 10^{-6}} = 4{\cdot}86 \times 10^5 \text{ ins.}$$

$$= 13{,}500 \text{ yds.}$$

THEORETICAL MECHANICS.

(ADVANCED AND HONOURS STAGES.)

BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, Geometry, etc., Morley College, London; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

Principle of Virtual Work.—The principle of virtual work or virtual velocities is frequently required in the various problems usually met with in mechanics, and may be applied with advantage in the various problems connected with simple machines, etc. There are many ways of stating the conditions; one good method is as follows:—

If the point of application of a force be *displaced* through a *small distance*, the resolved part of the displacement in the direction of the force is called its *virtual velocity*. If the force has a positive component in the direction of the displacement, the work done, or virtual work of the force, is measured by the product of the force and its displacement. In a similar manner, if any system of forces act on a body and are in equilibrium, then when any small displacement is given to the body, the sum of the virtual work of all the components is equal to the virtual work done by their resultant, and the total work done by all the forces is zero.

Let P denote a force acting on a particle at O, and OA a small displacement of the point O in a direction making an angle θ with that of the force P.

From A draw a perpendicular AB on the line of action of P. The work done by P is $P \times OB = P \times OA \cos \theta$.

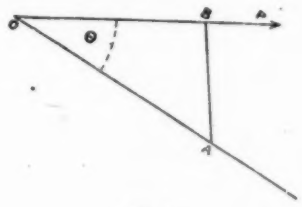


FIG. 1.

Ex. 3. Prove that the virtual work of a force is equal to the sum of the virtual works of its resolved components.

A smooth horizontal rail is parallel to a smooth wall, and one foot from it; a uniform beam 16 feet long rests over the rail, with one end pressing against the wall. Show that in the position of equilibrium the beam makes an angle of 60° with the horizontal. (1901.)

Let AB be the beam, and D the rail, one end of the beam A resting against the wall. Let l denote the length of the beam, and a the distance of D from the wall.

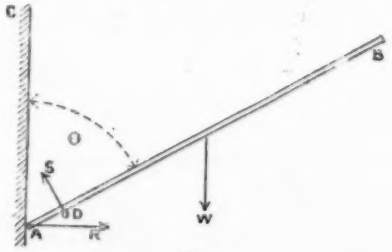


FIG. 2.

Let θ denote the angle BAC. The three forces acting are W, the weight of the beam; R, the reaction of the wall in a horizontal direction; and S, the reaction of the rail on the beam perpendicular to the beam.

$$\frac{a}{AD} = \sin\theta. \quad \therefore AD = \frac{a}{\sin\theta}.$$

Resolving horizontally, $R - S\cos\theta = 0$ . . . . . (1).

Resolving vertically, $W - S\sin\theta = 0$ . . . . . (2).

Taking moments about A,

$$S \times AD - W\frac{l}{2}\sin\theta = 0.$$

Substituting for AD, we have—

$$S \times a - \frac{Wl}{2}\sin^2\theta = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3).$$

From (2), $W = S\sin\theta$. Substitute in (3).

$$\therefore S \times a - \frac{Sl}{2}\sin^2\theta = 0.$$

$$\therefore \sin^3\theta = \frac{2a}{l}.$$

This gives the value of θ in terms of the lengths, distances a and l. Thus, in the question, where $l = 16$ feet, $a = 1$ foot.

$$\therefore \sin^3\theta = \frac{2}{16} = \frac{1}{8}.$$

$$\therefore \sin\theta = \frac{1}{2}.$$

Hence $\theta = 30°$.

Wheel and Axle.—This usually consists of a comparatively large wheel or pulley to which the effort or force is applied, and a smaller axle or drum on which the rope or cord supporting the weight is coiled. Let R be the radius of the wheel and r the radius of the axle, P the effort, and W the weight raised.

If P be made to move through a small arc $R\phi$ (where ϕ is the circular measure in radians subtended by the arc), then for a small displacement,

$$P \times r\phi = W \times r\phi.$$

$$\therefore \frac{P}{W} = \frac{r}{R}.$$

Smooth Screw.—Let R denote the radius of the circle described by the force P. If P were to make one complete rotation equal to $2\pi R$, then W would be raised through a distance equal to the pitch of the screw, or the distance between two threads.

Or $P \times 2\pi R = W \times p$, where p is the pitch. If the displacement of P be a small fraction of $2\pi R$ or $\frac{2\pi R}{n}$, then the displacement of W in the same time is $\frac{p}{n}$.

$$\therefore \frac{P}{W} = \frac{p \div n}{2\pi R \div n} = \frac{p}{2\pi R}.$$

The ratio $\frac{2\pi R}{p}$ is called the *mechanical advantage* of a smooth screw.

Ex. 4. Investigate the mechanical advantage of a smooth screw.

Find the ratio of the power to the weight in a screw which has ten threads to the inch, and is moved by a power acting perpendicular to an arm one foot long. As there are ten threads in an inch of length, the pitch is $\frac{1}{10}$ inch. (1902.)

$$\therefore P \times 2\pi \times 12 = W \times \frac{1}{10};$$

$$\text{or, } \frac{P}{W} = \frac{1}{10 \times 2\pi \times 12} = \frac{1}{240\pi}.$$

Ex. 5. Define the virtual moment (or virtual work) of a force.

Find the relation between the power and the weight in a screw press working without friction. What is the ratio of the weight to the power when the screw has four threads per inch, and the arm to which the power is applied is 2 feet long? (1892.)

Ans. 192 : 1.

Ex. 6. AB is a wall, and C a fixed point at a given perpendicular distance from it; a uniform rod of given length is placed on C, with one end against AB. If all the surfaces are smooth, find the position in which the rod is in equilibrium. (1890.)

Ans. $\cos^3\theta = \frac{c}{d}$, where θ = angle the rod makes with the horizon, c = distance of C from wall, and $2d$ equals length of rod.

Ex. 7. Give some simple examples of "the principle of virtual work."

Two forces, P and Q, acting at a point, make angles α, β with the resultant R. Show, from the principle of virtual work or otherwise, that whatever value be given to the angle ϕ, $R\cos(\alpha + \phi) = P\cos\phi + Q\cos(\alpha + \beta + \phi)$. (1900.)

Ex. 8. OA, AB are two uniform beams freely jointed at A, OA being movable about a hinge at O. If a force of P lbs. applied at B, at an angle θ with the vertical, causes a position of equilibrium in which the beams are equally inclined to the vertical, show that

$$P = \frac{1}{4}(W + 3W^1)\sec\theta,$$

where W, W^1 are the weights of OA and OB. (1902.)

OUR QUERY COLUMN.

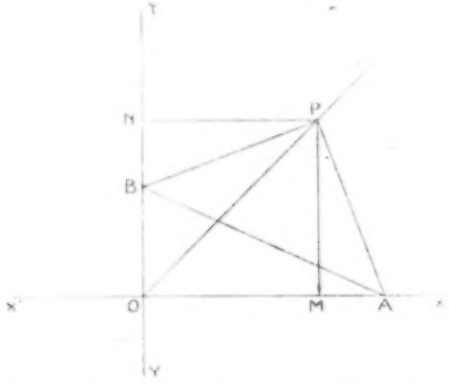
RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

Palabra.—You will find a full descriptive account in Ansted's *Physical Geography*, or a very good, though shorter, account in Macturk's *Physical Geography*. I have not yet seen Dr. Herbertson's new book, but I believe that will give you the information in the most up-to-date form.

James Guild.—OX, OY are two fixed straight lines at right angles to each other. APB is an isosceles triangle right angled at P. If A and B move on OX and OY respectively, prove that the locus of P is one or other of the straight lines which bisect the angles between OX and OY. (University Prelim., 1902.)



Let the Fig. represent any position of the given triangle APB consistent with the given conditions that A shall be on OX and B on OY. From P draw PM perpendicular to OX, and PN perpendicular to OY. Join OP. Because OX, OY are lines at right angles, and PM, PN have been drawn respectively perpendicular to OX and OY, therefore ONPM is a rectangle, and the angle NPM is a right angle. But by hypothesis the angle BPA is a right angle. Therefore the angle NPM is equal to the angle BPA. Taking away from each of these equal angles the angle BPM, which is common to both, the remaining angle NPB is equal to the remaining angle MPA. Hence, in the triangles PNB, PMA, the angles PNB, NPB are equal to the angles PMA, MPA, each to each, and the side PB is equal to the side PA (hypothesis); therefore PN is equal to PM (Euclid, I. 26).

Again, PN is equal to MO, and PM to NO (Euclid, I. 34), therefore NO, OP are equal to MO, OP, each to each, and PN is equal to PM. Hence the angle PON is equal to the angle POM (Euclid, I. 8).

Therefore for all positions of the given right-angled isosceles triangle APB, consistent with the conditions that A shall be on OX and B on OY, the vertex P lies on the straight line which bisects the angle between OX and OY.

Similarly, if A be in XO produced, and B in OY, it may be proved that P lies on the line which bisects the angle between OY and XO produced.

P.B. and *F.C.D.* (*Honours Physiography*).—There is no single book that covers the course for the Honours Stage of physiography. Every student should possess *Honours Physiography*, published by Messrs. T. Nelson and Sons; but this book does not pretend to cover the whole of the ground. It is only suggestive, and must be supplemented by other books, and, above all, by periodicals.

With respect to Kirchoff and Stokes, any standard work on Light, or the *Encyclopædia Britannica*, would give you special particulars under this head. *The Chemistry of the Sun* (14s.) and *Inorganic Evolution*, both by Sir Norman Lockyer, and published by Macmillan, should be read.

As for periodicals, it is difficult to give a list that is at the same time inclusive and yet within the reach of the ordinary student. London students will find all they want in the Science Library, South Kensington Museum, which is open free to 10 p.m. on Saturdays, Mondays, and Tuesdays.

Nature, *Knowledge*, *The Illustrated Scientific News*, *La Nature*, *La Revue Scientifique*, *Himmel und Erde*, *The Scientific American*, *The Proceedings of the Royal Society*, and the Journals of the Astronomical, Geological, and Meteorological Societies, *The Astrophysical Journal*, and *The Observatory*, are a few amongst many other periodical publications that might be perused with profit by the student. Perhaps the simplest course to follow would be to read *Nature* through, especially the parts dealing with the meetings of the various societies, and then to get the journals of the societies when any subject of the syllabus crops up.

J.B.H.A.C.P.—Solve the equations—

$$\left.\begin{aligned}\frac{ax-by+cz}{x(a+c)-by}&=\frac{ay-bz+cx}{y(a+c)-bz}=\frac{az-bx+cy}{z(a+c)-bx}\\ ax+by+cz&=1\end{aligned}\right\},$$

where $x+y+z$ is not zero.

Let $\dfrac{ax-by+cz}{x(a+c)-by}=\dfrac{ay-bz+cx}{y(a+c)-bz}=\dfrac{az-bx+cy}{z(a+c)-bx}=r.$

Then $ax-by+cz=r\{x(a+c)-by\}$,

$ay-bz+cx=r\{y(a+c)-bz\}$,

$az-bx+cy=r\{z(a+c)-bx\}$.

$\therefore (a-b+c)(x+y+z)=r\{(a-b+c)(x+y+z)\}$.

Then, since $(x+y+z)$ is not zero, we have (if we may assume that $(a-b+c)$ is not zero) $r=1$.

Hence $ax-by+cz=x(a+c)-by$.

$\therefore cz=cx$.

$\therefore z=x$.

Also $ay-bz+cx=y(a+c)-bz$.

$\therefore cx=cy$.

$\therefore y=x$.

Hence $x=y=z$.

Then from the given equation

$ax+by+cz=1$,

we have $ax+bx+cx=1$.

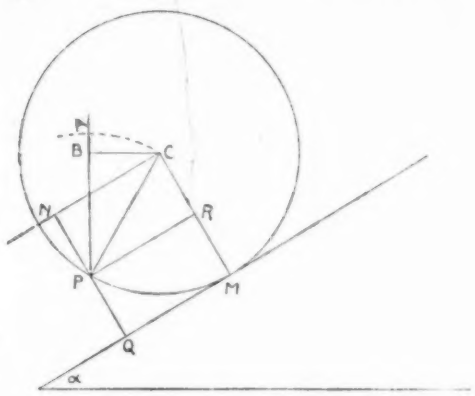
$$\therefore x=\frac{1}{a+b+c}.$$

Hence $x=y=z=\dfrac{1}{a+b+c}$.

Esk.—A perfectly rough and rigid hoop rolling down an inclined plane comes in contact with a spike. Show that if the radius of the hoop is r, the height of the spike $= \frac{r}{2}$ above the plane, and V = velocity just before impact, then the condition that the hoop will surmount the spike is that

$$V^2 > \frac{16}{9}gr\left\{1 - \sin\left(\alpha + \frac{\pi}{6}\right)\right\},$$

α being the angle of the plane. Show also that the hoop will not remain in contact with the spike at all unless $V^2 < \frac{16}{9}gr \sin\left(\alpha + \frac{\pi}{6}\right)$. (Hicks's *Dynamics.*)



If PQ in the Fig. represents the spike, PA the vertical through P, CB the horizontal through C the centre of the hoop, CM the perpendicular to the plane, and CN, PR lines drawn parallel to the plane; then because PQ = ½CM, ∴ CR = ½PC. Hence the angle PCR = 60°; and the angle NCP = 30°, or $\frac{\pi}{6}$. Again, since BC is horizontal, and CN parallel to the plane, therefore the angle BCN = α. Hence the angle BCP = $\left(\alpha + \frac{\pi}{6}\right)$. Then if PA is taken = PC, we have BA = $r\left\{1 - \sin\left(\alpha + \frac{\pi}{6}\right)\right\}$.

Before impact, the moment of momentum about P is $mwr^2 + mV \cdot NP$, and this is equal to $mVr + mV\frac{r}{2}$ or $\frac{3}{2}mVr$.

After impact, taking w' to represent the new angular velocity, the moment of momentum about the same point P is $mw'2r^2$, since the momentum generated by the impact has no momentum about P.

We have, therefore, $\frac{3}{2}mVr = 2mw'r^2$.

$$\therefore w' = \frac{3}{4}\frac{V}{r}.$$

Again, the kinetic energy after impact is equal to $\frac{1}{2}Iw'^2$, where I is the moment of inertia of the hoop about a horizontal axis through P, and is therefore equal to $m2r^2$.

Hence the kinetic energy after impact is

$$\tfrac{1}{2}m2r^2\left(\frac{3}{4}\frac{V}{r}\right)^2 \text{ or } m\frac{9}{16}V^2.$$

Now, if the hoop is to surmount the spike, it is obvious that the centre of mass must be raised through the vertical height BA, which we have seen is equal to

$$r\left\{1 - \sin\left(\alpha + \frac{\pi}{6}\right)\right\}.$$

The energy required to accomplish this is given by the expression $mgr\left\{1 - \sin\left(\alpha + \frac{\pi}{6}\right)\right\}$.

Hence the kinetic energy, $m\frac{9}{16}V^2$, must be greater than

$mgr\left\{1 - \sin\left(\alpha + \frac{\pi}{6}\right)\right\}$—that is,

$$V^2 > \frac{16}{9}gr\left\{1 - \sin\left(\alpha + \frac{\pi}{6}\right)\right\}.$$

We have seen that, after impact, the hoop rotates about a horizontal axis through P with angular velocity w', where $w' = \frac{3}{4}\frac{V}{r}$. Hence the external force acting along CP necessary to keep the hoop in contact with the spike is given by mw'^2r—that is, by $m\frac{9}{16}\frac{V^2}{r}$. But the external force acting on the hoop in the direction CP is the resolved part of its weight in that direction—that is, mg cos BPC. Hence we cannot have $m\frac{9}{16}\frac{V^2}{r}$ greater than mg sin $\left(\alpha + \frac{\pi}{6}\right)$; that is, V^2 must not be greater than $\frac{16}{9}gr$ sin $\left(\alpha + \frac{\pi}{6}\right)$ if the hoop is to remain in contact with the spike.

H.C.H.—Sum the following series:—

$y^2 + 2b$, $y^4 + 4b$, $y^6 + 6b$ . . . to n terms.

(Hall and Knight's *Elementary Algebra.*)

The given series is obviously the sum of two series—namely,

$y^2 + y^4 + y^6 + \ldots$ to n terms, ... (i)

and $2b + 4b + 6b + \ldots$ to n terms. . . . . (ii)

(i) is a geometrical series whose first term is y^2, and whose common ratio is $\frac{y^4}{y^2}$ (that is, y^2).

Now the sum of n terms of a geometrical series is

$$a \cdot \frac{r^n - 1}{r - 1},$$

where a is the first term and r the common ratio. Hence the sum of series (i) to n terms is

$$\frac{y^2\{(y^2)^n - 1\}}{y^2 - 1}, \text{ or } y^2 \cdot \frac{y^{2n} - 1}{y^2 - 1}.$$

Again, (ii) is an arithmetical series whose first term is $2b$ and common difference $2b$. Now the sum of n terms of an arithmetical series is $\{2a + (n-1)d\}\frac{n}{2}$, where a is the first term and d the common difference. Therefore the sum of the series (ii) is $\{2(2b) + (n-1)2b\}\frac{n}{2}$, or $\{(n+1)2b\}\frac{n}{2}$, or $n(n+1)b$.

Hence the sum of $y^2 + 2b$, $y^4 + 4b$, $y^6 + 6b$ . . . to n terms is $\frac{y^2(y^{2n} - 1)}{y^2 - 1} + n(n+1)b$.

Black Bishop.—If $x + \frac{1}{y} = y + \frac{1}{z} = z + \frac{1}{x}$, show that $x^2y^2z^2 = 1$, or $x = y = z$. (C. Smith's *Treatise on Algebra.*)

Taking the difference of the first and second of the given equations, we have—

$$x - y = \frac{1}{z} - \frac{1}{y}.$$

$$\therefore yz(x - y) = y - z \ldots\ldots\ldots \text{(i)}.$$

Similarly, from the second and third of the given equations, we have—

$$zx(y - z) = (z - x) \ldots\ldots\ldots \text{(ii)}.$$

And from the third and first, we have—

$$xy(z - x) = (x - y) \ldots\ldots\ldots \text{(iii)}.$$

Hence, by multiplication, we have—

$$x^2y^2z^2)x - y)(y - z)(z - x) = (y - z)(z - x)(x - y).$$

Therefore, either $x^2y^2z^2 = 1$, or $(x - y)(y - z)(z - x) = 0$; that is, either $x^2y^2z^2 = 1$, or $x = y = z$.

S. Edwardson.—A glass bottle, together with its glass stopper, weighs 45 grammes when empty; it will hold 185 cubic centimetres of water. When 160 cubic centimetres of water are put inside the bottle, and the stopper is inserted, it will just not sink in water. How many cubic centimetres of glass do the bottle and stopper contain? What is the specific gravity of the glass? (King's Scholarship Examination, 1901.)

Let v denote the number of cubic centimetres of glass contained in the bottle and stopper, and let σ denote the specific gravity of the glass. Then $v\sigma$ = the weight in grammes of the bottle, together with its stopper, when empty.

$$\therefore v\sigma = 45 \ldots\ldots\ldots \text{(i)}.$$

Now the volume of water displaced by the stoppered bottle when completely immersed = (185 + v) cubic centi-

metres. Assuming that 1 cubic centimetre of the water weighs 1 gramme, the weight of the water displaced $= (185 + v)$ grammes.

By the principles of hydrostatics, the weight of the water displaced is equal to the total weight of the body immersed. Therefore $(185 + v) = v\sigma + 160$ . . . . . (ii).

But from (i) $v\sigma = 45$.

$$\therefore 185 + v = 45 + 160.$$

$$\therefore v = 20.$$

Hence, and from (i), $\sigma = \frac{45}{20} = 2.25$.

Therefore the bottle and stopper together contain 20 cubic centimetres of glass, and the specific gravity of the glass is 2.25.

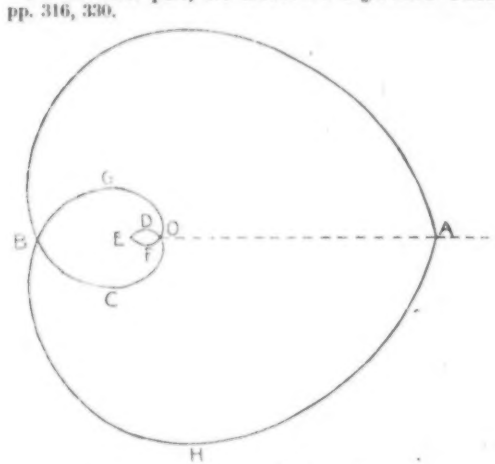
Beginner.—How would you discover the existence of loops in a curve expressed in (i) cartesians, (ii) in polar co-ordinates?

How many loops are there in the following curves, and between what limits do they lie?—

(*a*) $r = a(\frac{1}{2}\sqrt{3} + \cos\frac{1}{2}\theta)$.

(*b*) $r^2 - 2ar - 8ar + 9a^2 = 0$.

For the first part, see Edwards's *Differential Calculus*, pp. 316, 330.



(*a*) When $\theta = 0$, we have $r = a\left(\frac{\sqrt{3}}{2} + 1\right) = \text{OA}$, say. As θ increases from zero to π, $\cos\frac{\theta}{2}$ diminishes from 1 to zero, and r decreases continuously from $a\left(\frac{\sqrt{3}}{2} + 1\right)$ to $a\frac{\sqrt{3}}{2}$, as is shown by the upper part of the outer loop from A to B. Whilst θ increases from π to $\frac{5}{3}\pi$, the radius r decreases from $a\frac{\sqrt{3}}{2}$ to zero, as shown by the arc BCO. Increasing θ from $\frac{5}{3}\pi$ to 2π, we have r negative, and varying from zero to $-a\left(1 - \frac{\sqrt{3}}{2}\right)$, giving us the arc ODE in the figure. Continuing to increase θ from 2π to 4π, we have the image of the previous portion of the curve, as in a mirror along OA, giving us the portion EFOGBHA.

(*b*) The given equation may be written $(r - a)(r - 9a) = 0$, which form shows that the locus consists of two concentric circles, $r = a$ and $r = 9a$.

(Kindly observe rule 3.)

Borax.—The melting point of copper is 1090° C.; how is this ascertained? Describe an instrument for measuring high temperatures. (Sandhurst Examination Paper.)

High temperatures may be readily measured by the aid of a suitable thermo-couple. For this purpose a wire of platinum and another of an alloy of platinum and iridium (or platinum and rhodium) are used. One junction, A, is placed in the position of which the temperature is required; while the other junction, B, is kept at a constant temperature by being surrounded by steam. A sensitive reflecting galvanometer is included in the circuit, and each temperature of the junction A will correspond to a certain deflection of the galvanometer.

To determine the melting point of copper, the junction A is placed in a crucible containing melted copper, and the galvanometer deflection is read, say, every half-minute. As the copper cools, the deflection of the galvanometer decreases; but when the copper commences to solidify, its temperature remains constant until solidification is complete, when the temperature recommences to fall. Thus, by observing the deflection of the galvanometer when it remains constant for some time, the melting point of copper becomes known if we know the temperature to which this deflection corresponds. The latter point can be determined in several ways. The junction A may be enclosed in an air thermometer, and the galvanometer deflection for various temperatures can be determined, and a curve can be drawn showing the connection between temperature and deflection. Or the junction A may in turn be placed in crucibles containing melted metals of various kinds of which the melting points are known, and the deflection of the galvanometer can be observed in each case when it remains constant for a short time, and a curve connecting temperature and deflection can be drawn as before. For fuller information, see Edser's *Heat for Advanced Students* (Macmillan and Co.), chap. xix.

Arum.—A small error x is made in measuring the side a of a triangle, a small error y in measuring b, and a small error n'' in measuring C. Prove that the consequent errors in A and B are each $\frac{1}{2}n''$, provided that the relation

$$2\frac{bx - ay}{a^2 - b^2}\sin C = n \sin 1''$$

be satisfied. (Edwards's *Differential Calculus for Beginners.*)

We have

$$A + B = 180° - C. \quad \therefore dA + dB = -dC. \quad . \; . \; . \quad (1)$$

$$\tan\frac{A - B}{2} = \frac{a - b}{a + b}\cot\frac{C}{2} = f(a, b, C) \text{ (say)}. \; . \; . \; . \quad (2)$$

$$\text{From (2), } A - B = 2\tan^{-1} f(a, b, C). \quad . \; . \; . \; . \quad (3)$$

Now, if C varies by dC, the value of $\cot\frac{C}{2}$ varies by

$$\frac{\cos\left(\frac{C}{2} + \frac{dC}{2}\right)}{\sin\left(\frac{C}{2} + \frac{dC}{2}\right)} - \frac{\cos\frac{C}{2}}{\sin\frac{C}{2}}$$

$$= \frac{\cos\left(\frac{C}{2} + \frac{dC}{2}\right)\sin\frac{C}{2} - \sin\left(\frac{C}{2} + \frac{dC}{2}\right)\cos\frac{C}{2}}{\sin\left(\frac{C}{2} + \frac{dC}{2}\right)\sin\frac{C}{2}}$$

$$= -\frac{\sin\left\{\left(\frac{C}{2} + \frac{dC}{2}\right) - \frac{C}{2}\right\}}{\sin\left(\frac{C}{2} + \frac{dC}{2}\right)\sin\frac{C}{2}} = -\frac{\sin\frac{dC}{2}}{\sin^2\frac{C}{2}}.$$

Let A and B respectively vary by dA and dB when a is increased by da, b is increased by db, and C is increased by dC.

Then from (3),

$$dA - dB = 2\frac{1}{1 + \{f(a, b, C)\}^2} \times$$

$$\left\{\left(\frac{2b\,da}{(a + b)^2} - \frac{2a\,db}{(a + b)^2}\right)\cot\frac{C}{2} - \frac{a - b}{a + b}\frac{\sin\frac{dC}{2}}{\sin^2\frac{C}{2}}\right\}$$

When the quantity within the brackets to the right of this equation is equal to zero, $dA - dB = 0$, or $dA = dB$. For this to hold,

$$2\frac{b\,da - a\,db}{(a + b)^2}\cdot\left(\frac{a + b}{a - b}\right)\cot\frac{C}{2}\cdot\sin^2\frac{C}{2} - \sin\frac{dC}{2} = 0. \quad . \; . \quad (4)$$

If now $dC = n''$, $\sin\frac{dC}{2} = \frac{n}{2}\sin 1''$, to a first approximation. Substituting this, and $da = x$, $db = y$, in (4), we obtain

$$2\frac{bx - ay}{a^2 - b^2}\cos\frac{C}{2}\sin\frac{C}{2} = \frac{n}{2}\sin 1''.$$

$$\therefore 2\frac{bx - ay}{a^2 - b^2}\sin C = n \sin 1''.$$

This is the condition that $dA = dB$. When it is complied with, we may substitute in (1), obtaining

$$dA + dB = 2dA = -dC = -n''.$$

$$\therefore A = B = -\frac{n''}{2}.$$

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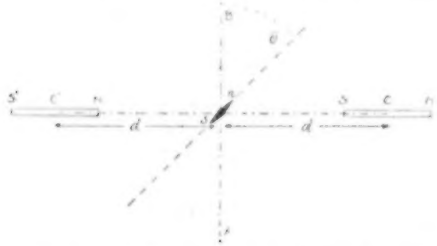
Luda.—Given a bar magnet, a small charm compass, a metre scale, and a full sheet of drawing-paper, find the pole strength of the bar magnet, assuming H = 0·16.

(London B.Sc. Preliminary, 1902.)

Draw two lines at right angles to each other across the paper, intersecting near the middle point of the latter; place the paper on a table, and, by the aid of the compass, adjust it so that one arm of the cross lies due north and south. Place the charm compass at the intersection of the arms of the cross, and note the reading of the compass needle. Then place the bar magnet (N S) along the



E to W arm of the cross at such a distance from the compass that the needle is deflected through 45°, which we may term the angle θ. Turn the magnet end for end, and again observe the deflection of the compass needle. Then place the bar magnet on the opposite side of the compass at N′ S′, the middle point of the bar magnet being at the same distance from the compass needle as before; read the deflection of the compass needle, and after turning the magnet end for end, again read the compass needle. The mean of the four deflections of the compass needle may be substituted for θ in the equation

$$M = \frac{Hd^3}{2} \tan \theta,$$

where M = magnetic moment of magnet,
H = earth's horizontal component field—that is, 0·16,
d = distance from middle point of bar magnet to compass needle.
If m = pole strength of bar magnet,
l = length of bar magnet,
then $M = ml$, if we assume the poles to be at the extreme ends of the bar magnet.

Another method of procedure would be as follows:—After removing bar magnet to a distance, set the compass needle oscillating, and determine the time, T_1, of one complete oscillation. Then place the bar magnet due north or south of the compass needle and pointing to the latter, and determine the time, T_2, of an oscillation of the needle. If F is the field at the centre of the compass needle due to the bar magnet, then

$$\frac{F + H}{H} = \frac{T_1^2}{T_2^2}.$$

$$\therefore \frac{F}{H} = \frac{T_1^2 - T_2^2}{T_2^2},$$

$$\text{and } F = H \frac{T_1^2 - T_2^2}{T_2^2}.$$

The relation

$$F = \frac{2M}{d^3} = \frac{2ml}{d^3}$$

then serves to determine m when l and d are known.

Aliter.—Since AC, DF, CB are in H.P.

$$\therefore \frac{AC - DF}{DF - CB} = \frac{AC}{CB}.$$

Hence AC . CB − DF . CB = AC . DF − AC . CB.

$\therefore$ 2AC . CB = DF (AC + CB) = DF (2AO).

$\therefore$ AC . CB = DF . AO.

Hence $AO^2 - OC^2 = DF . AO$.

$\therefore AO^2 - DO . OF = DF . AO$.

$\therefore AO^2 - DO . OF = AO (DO - OF)$.

Hence (AO − DO) (AO + OF) = 0.

$\therefore$ AO = DO.

Hence the circle on AB as diameter passes through D. Also the line joining the centres of the circles passes through D; therefore the circles touch at D.

H. D. Stanley.—To complete a certain work A requires m times as many days as B and C together, B requires n times as many as A and C together, and C requires p times as many as A and B together. Compare the times in which each would do it, and prove that $\frac{1}{m+1} + \frac{1}{n+1} + \frac{1}{p+1} = 1$.

(Wrigley's Examples.)

Let x be the number of days A requires to complete the work,
y be the number of days B requires to complete the work,
and z be the number of days C requires to complete the work.

Then A does $\frac{1}{x}$ of the work in one day,

B does $\frac{1}{y}$ of the work in one day,

and C does $\frac{1}{z}$ of the work in one day.

Hence B and C, working together, would do $\left(\frac{1}{y} + \frac{1}{z}\right)$ of the work in one day—that is $\frac{y+z}{yz}$ of the work in one day. Therefore B and C, working together, would complete the work in $\frac{yz}{y+z}$ days.

Similarly, C and A, working together, would complete the work in $\frac{zx}{z+x}$ days; and A and B together would complete the work in $\frac{xy}{x+y}$ days.

Therefore, by the question, we have

$$x = m \cdot \frac{yz}{y+z}.$$

$$y = n \cdot \frac{zx}{z+x}.$$

$$z = p \cdot \frac{xy}{x+y}.$$

Hence $xy + zx = myz$. . . . . (i)

$yz + xy = nzx$. . . . . (ii)

$zx + yz = pxy$. . . . . (iii)

From (i) and (ii) by subtraction we have

$z(x - y) = z(my - nx)$.

$\therefore x - y = my - nx$.

$\therefore x + nx = my + y$.

$\therefore x(n + 1) = y(m + 1)$.

Hence $\frac{x}{y} = \frac{m+1}{n+1}$.

Again, from (ii) and (iii) we have

$x(y - z) = x(nz - py)$.

$\therefore y - z = nz - py$.

$\therefore y + py = nz + z$.

$\therefore y(p + 1) = z(n + 1)$.

Hence $\frac{y}{z} = \frac{n+1}{p+1}$.

$\therefore x : y : z :: m + 1 : n + 1 : p + 1$.

Hence the times in which A, B, and C would severally complete the work are as $(m + 1) : (n + 1) : (p + 1)$.

Further, from (i) we have

$$m = \frac{xy + zx}{yz}.$$

$$\therefore m + 1 = \frac{xy + zx}{yz} + 1 = \frac{xy + yz + zx}{yz}.$$

$$\therefore \frac{1}{m+1} = \frac{yz}{xy + yz + zx}.$$

Similarly, from (ii) we may show that

$$\frac{1}{n+1} = \frac{zx}{xy + yz + zx},$$

and from (iii) that

$$\frac{1}{p+1} = \frac{xy}{xy + yz + zx}.$$

Therefore

$$\frac{1}{m+1} + \frac{1}{n+1} + \frac{1}{p+1} = \frac{1}{xy + yz + zx}(yz + zx + xy).$$

Therefore $\frac{1}{m+1} + \frac{1}{n+1} + \frac{1}{p+1} = 1$. *Q.E.D.*

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RULES.

1. All translations should be **posted not later than Feb. 8,** and addressed:—*Prize Editor*, Office of the PRACTICAL TEACHER, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.

ALTERATION IN RULE 3.

3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

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Pourtant, il faut dire toute la vérité. Au milieu des prodiges de leur industrie, de leur police et de leurs renoncements, une chose nous surprendra toujours et interrompra notre admiration: C'est leur indifférence à la mort et au malheur de leurs compagnes. Il y a dans le caractère de l'abeille un dédoublement bien étrange. Au sein de la ruche, toutes s'aiment et s'entr'aident. Elles sont aussi unies que les bonnes pensées d'une même âme: Si vous en blessez une, mille se sacrifieront pour venger son injure. Hors de la ruche elles ne se connaissent plus. Mutilez, écrasez—ou plûtot gardez-vous d'en rien faire, ce serait une cruauté inutile, car le fait est constant—mais enfin supposons que vous mutiliez, que vous écrasiez sur un rayon posé à quelques pas de leur demeure, dix, vingt ou trente abeilles sorties de la même ruche, celles que vous n'aurez pas touchées ne tourneront pas la tête et continueront de puiser au moyen de leur langue, fantastique comme une arme chinoise, le liquide qui leur est plus précieux que la vie, inattentives aux agonies dont les derniers gestes les frôlent et aux cris de détresse que l'on pousse autour d'elles.

MAURICE MAETERLINCK.

RESULT OF THE DECEMBER COMPETITION.

The prize is awarded to "U.V.F.L." (Will "U.V.F.L." kindly send name and address?)

First Class.—Oakover, Chemineau, Aiphos, C.E.M., Fabien Mouillard, Buxtona, Natalis, Nell of Tarc, Misther O'Toole, Pegarita, Myosotis, One of them, Kettering, Jungwolfia, Daydawn, Agaznog, Carma, Half loaf, St. Fittick, Logic, Thule, Maid Marian, Veronica, Verdant, J.D.A., Stour, Sans bois, Josiah, A. Bhoidheach, Tyro, Elaine, Thaddea, Anglo-franco, La Printanière, Soton, One of them (Hastings), Esther, Judith, Magdalen, Nemo, Nina, Lady Lucy, Pellonia, Ichthus, Weissenfelz, Rus, Ironopolis, Marly, Naec, Wooldale, Marquise, Marwenne, J.H.O.D., Greta, Plain Mary, Mynoduesp, Alic Dunbar, Arche, Lotus, Nil desperandum, Calder, Moloch, Dædalus, Donald, Caledonia, François, Bonny Briar, Excelsior, Critchon, Bull-dog, Rogue, Maiden City, Ephesian, Southwood, Portia, Stulta, Beryl, Kylra, Partick, Antoinette, Kit, Paradox, Ennell, Lorton Vale, Ladislas, Gladiator, St. Gudule, Manx Cat, M.G.I., Two little maids from school, Cedric, Quarterly, Franz, Follefarine, Neppydhu, Croissant, Stag, Norah, Jus de pomme, Rosalind, Frog, Morag Darroch.

Second Class.—Une écolière, Kitten, Mac, Eclito, Cathie, A.M.D.G., Sally Brass, Barkey, Dynevorian, Septima, Mistletoe, May M'Namara, Bam, Billy Green, Brigitte, L'orient, Petite-amie, Kismet, Gert, Belgrave, De Couriez, Hovan, Amateur, Fleur-de-lis.

Third Class.—Morganwg, J.G.A.

Report.

A large number of very creditable translations has been sent in. The idea of the piece is easily grasped, and hence few candidates made any glaring errors. One candidate, with excessive literalness, translates *Ces vieilles filles* as "These aged girls;" and another very ingeniously renders *saison mûre* by "mulberry season." A rather large number, in translating *Le sang...a eu beau gronder*, betrayed an insufficient acquaintance with the usages of their mother tongue. The blood is variously said to "mutter," "growl," "roar," "grumble," and "rumble," instead of to "pulse," "surge," "course," etc.

The prize-winner of the November competition ("Snipe") was Miss E. E. Wood, Stonehurst, Buxton.

Prize Translation.

These old maids that are laughed at should rather be reverenced, considering the secret suffering of their voluntary seclusion. They have been young, loving, passionate as others, and have seen their friends leave them, one by one, for the arms of a husband. After the marriage of the last they have come back from the church sad and alone to their quiet dwelling, and have been obliged to resign themselves to their fate in the midst of youth. The hot blood has pulsed tumultuously in their heart as in a full and pent-up reservoir: they have silenced it. To stop the flower-buds of tenderness from expanding outwardly, religion, duty, honour existed, stern barriers festooned with creepers which desired only to flower, but will never do so. What sad inward struggle! And when each spring returned, what bitter mockery, what terrible trials, what secret troubles! So year was added to year, autumn to autumn, winter to winter, until the day when the white hairs brought with them a cold indifference. Many of these virgin Niobes, it is true, know not how to submit, and become bitter in their maturity; but those who in that cruel ordeal have been able to keep intact their suppressed affection are adorable. They attain old age like trees, rich in sap under their rough exterior, which yield after long years the best-flavoured and most sweet-scented fruits.

U.V.F.L.

RESULT OF THE FOREIGN AND COLONIAL COMPETITION.

The prize is awarded to "Concetta," the pseudonym of Miss Christina Bandeira, 3 Boulevard de la Saussaye, Neuilly-sur-Seine, France.

First Class.—Diogenes Junior (Victoria), Sans Dictionnaire (Cape Colony), Irénée (France), Hibiscus (Jamaica), Tommy (Singapore), Guy (Barbadoes).

Second Class.—Jersey Eyes (Jersey).

Report.

The disappointing number of competitors is probably due to a misunderstanding as to the time to be given to competitors. Although this misunderstanding was corrected in the October number of the magazine, it probably resulted in our receiving but one paper from Australia. This only came in at the last moment. The general merit of the papers is high. All encountered a difficulty with the phrase *anonymat républicain*. It no doubt means "impersonal government," as opposed to the personal government by a monarch. We received three papers from competitors at home who did not sufficiently notice the conditions of the competition.

Translation.

Besides, what *are* departments? Nothing but mere geographical divisions. The various provinces, not wishing to acknowledge the domination of one of themselves as ruler, but seeking a unity of government under one central power, in which they would all participate, the result was that France split herself up into a thousand parts. So it is evident that Paris is quite indispensable, though at the same time very formidable. In proportion to the power the democracy acquires, Paris is at once more necessary, yet also more to be feared. Present-day governments, whose future is so precarious, dare not so much as try to solve the problem: they hide themselves in the midst of the great capital, or near it, and are ever fearful of its roars. Like a good-natured fellow, Paris lets things go easily, elects its own municipal Council, whether Radical or Nationalistic, whose members refuse connection with the government, hold their heads high before prefects, and yet dine with ministers, solemnly welcome the President, loudly cheer potentates when travelling in the country, befriend literature and art, and protect long-standing institutions. In fine, Paris, knowing its strength and its duties, laughs at its own excesses, and allows everything to go on smoothly so long as its own work, its own prejudices and precedents, and its own methods are not tampered with. Such is the compromise which ever continues in favour of republican joint-stock nameless government. It may be that some unwritten law will arise out of this understanding, one of those tacit compacts on the strength of which men live for generations.

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The Making of Citizens: A Study in Comparative Education. By R. E. Hughes, M.A. (Oxon.), B.Sc. (Lond.), author of *Schools at Home and Abroad*. (Contemporary Science Series.) Mr. Hughes has performed a task which renders all English-speaking educationists his debtors. Many valuable books and articles have appeared from time to time in English dealing with the school system of France or of Germany or of other countries, not the least valuable being the *Special Reports* recently issued by the Board of Education. The want has often been felt of something more general, with perhaps less detail, which would enable us to compare with each other the educational systems and their results in those nations which lead the van in civilisation, or in education, which is the same thing. Mr. Hughes has set himself to marshal in systematic order the facts concerning schools and teachers and pupils in England, Germany, France, and America, with the aim of permitting such comparisons to be made as are possible, for there are many points in which each nation has developed individualities impossible to be related quantitatively with those of other nations. The book is one which cannot be criticised in detail in a few sentences, and as to its general plan and execution criticism can only take the form of praise. The full reviews given first of the primary school, and next of the secondary school, in each country, are based on full but concise official statistics, and do not leave much space for the opinions of the writer. These, where given, are temperate and clear, as might be expected from one whose patience has been adequate to the collection and analysis of so much material. A hasty reader of the book cannot help regretting that no use has been made of the graphic method in presenting the statistics, but on the other hand this is emphatically not a book for hasty reading.

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German for the English. A First Reading Book, consisting of easy poems, with interlinear translations, and illustrated by notes and tables, chiefly etymological. By A. Sonnenschein and G. S. Stallybrass. (Fifth edition.) This is an able and ingenious work, and deserves the popularity which it has attained. The aim throughout is to attack German through English. This is done first by giving lists of words which are practically the same in both languages, the modifications being explained in accordance with what every student has regarded as the "law of gravitation" in the linguistic sphere—Grimm's Law. In the second part word-building is introduced, and here full use is made of parallel usage between the two tongues in the employment of prefixes and suffixes. This section will do much to give a vocabulary to the thoughtful student, and is most suggestive even to the casual reader. The third part consists of easy German poems, with an interlinear translation in English—a system which had once great vogue and has still many advantages for the student of somewhat mature age. The notes at the foot of each page call attention to useful etymological connections between the two languages. In part four the same poems are given in German alone, in order that the student may test himself or be tested as to his knowledge of the meaning, and enjoy the poem apart from the now distracting lines of English. The final part consists of easy prose narrative, figured liberally with references to the full notes which follow. An appendix of exercises for re-translation, based on each German extract, and a full index, close a very useful text-book for school or home. Special mention should be made of a few most ingenious diagrams to show how words are built up from simple roots. A volume of such diagrams alone would be a book to treasure.

JOHN TOMLINSON.

Manual of Musical, Physical, and Squad Drill for Boys, Girls, and Cadets. By William Walker, drill instructor, Hillhead High School, Glasgow, etc. With introduction by Professor J. G. M'Kendrick, M.D., LL.D., F.R.S. (Third edition.) This is a useful manual, dealing with a subject which is at present attracting a large amount of notice. The first part of the book is devoted to military drill, and incorporates the whole of the squad drill of the recently issued *Infantry Training*. The latter part takes up physical exercises with and without music, free exercises, and exercises with dumb-bells, wands, rings, bar-bells, and long poles. Numerous photographs are given to illustrate the correct positions of the pupil. Regarding these one feels that a somewhat larger size would have been a great advantage in every case, while some of the positions shown strike one as being not quite in accordance with the instructions in the text; and one hopes that the high-heeled shoes worn by one young lady were assumed in honour of the photographer, and not by order of the drill-instructor. The instructions given in the book are of the briefest, in many cases, but this is probably to be explained by the remark in the preface that the exercises "are primarily intended as memory aids to teachers attending a course of instruction." It is not in every case that "they have been stated with clearness and detail sufficient to enable those who cannot attend classes to put them into practice by private study," unless that study is very thorough indeed.

UNIVERSITY TUTORIAL PRESS.

First Stage Mathematics. This book consists of two sections, containing the Euclid and Algebra required for the South Kensington Syllabus, with the last twenty years' papers in arithmetic. The geometry is reproduced from Deakin's larger work, and contains all the useful notes and additional exercises found there. The algebra section is disappointing, many of the explanations being quite inadequate for an intelligent appreciation of the processes involved. This is particularly noticeable in the treatment of negative quantities, the rule of signs for multiplication, the use of brackets, and the various operations with fractions. The exercises are numerous, and include some examples selected from first-stage papers; but unless supplemented by good teaching, this section is not likely to assist in the attainment of any real knowledge of elementary algebra.

T. FISHER UNWIN.

The Teacher and the Child: Elements of Moral and Religious Teaching in the Day School, the Home, and the Sunday School. By H. Thiselton Mark, B.A. (Lond.), B.Sc. (Vict.), Master of Method, Owens College, Manchester, etc. Notwithstanding the somewhat formidable sub-title, this book is not a dull or dry one. The preface describes it better: "The chapters are half-hours of educational theory, addressed mainly to volunteer workers in education, whether in the Sunday school, the night school, or in the home." The writer has also in view the needs of pupil teachers and first-year students in training colleges. We are pleased to see a book on this subject written on such lines. The initial and central and all-pervading idea of it is the child as a living, growing person. To the child and the laws of his growth everything in education must be related and adjusted. The writer is very successful in presenting to the uninitiated the rules of method which he finds based on child-nature, and would make all Sunday-school teachers into good Herbartians and child-students by the shortest road possible, in which most laudable effort we wish him all success. The ideas will be new to most Sunday-school teachers, and will be helpful to all who assimilate them. But even to regard Sunday-school teaching as in any real sense a part of education will startle many at first. In future editions, which should be many, the writer would do well to expand further the chapter on "The Teacher's Obstacles." Such writing is specially useful to the well-meaning amateur.

WESTWORTH AND SONS.

Practical Mathematics for Elementary Students. By Jesse O. Wentworth. This is a hopelessly inaccurate work. We can only find space for a few samples of the kind of information which is assumed by the writer to form part of a course in practical mathematics. See p. 15—"In working any sum in decimals it is never necessary to bring the answers out further than four decimal places." What would happen if the first four decimal places happened to be ciphers we are at liberty to guess, but no information is given. See p. 35—"Five statements of a rule are necessary to show that if $4 \times 2 \times 5 \times 6 = 240$, then any single factor on the left can be obtained by dividing 240 by the product of the remaining three." Page 29—"Here is another formula with respect to boilers and thick cylinders. The relation between the diameter d, internal pressure p, thickness t, and safe or ultimate stress f, is obtained from $Pd = 2tf$." Where the P comes from is not explained, nor yet what relation this has to a thick cylinder, but engineers may be glad to find that the problem of dealing with a thick cylinder is such a simple matter after all.

In the pages concerned with mensuration there is *throughout* confusion between numbers and their logarithms. Thus on p. 47—"$5{\cdot}35 \times 4{\cdot}38 = \log 5{\cdot}35 + \log 4{\cdot}32 = 1{\cdot}3639 = \log 23{\cdot}12$."

Many other instances could be cited. In addition we find some remarkable statements. Thus on p. 81—"A curve which will give us all values of saucepans from 0 pints to 30 pints." A saucepan of "0 pints" would be a rather interesting exhibit.

It will be seen from the preceding that there is enough material for an average student to correct. In all other respects the book is absolutely worthless or worse.

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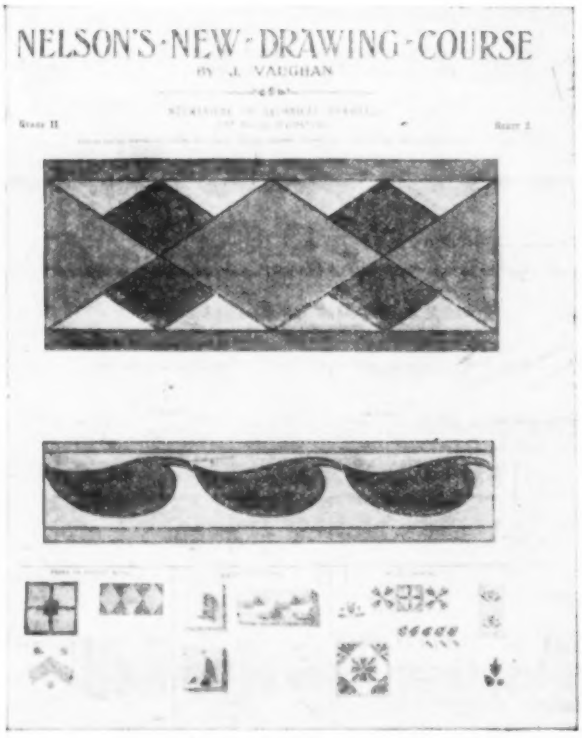

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